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FIELD SAMPLING PLAN
OUTBOARD MARINE CORPORATION
WAUKEGAN, LAKE COUNTY, ILLINOIS

Prepared for
U.S. Environmental Protection Agency
Region 5 Emergency Response Branch
77 West Jackson Boulevard
Chicago, Illinois 60604

TDD No.	:	S05-0202-004
Date Prepared	:	01 Mar 02
Contract No.	:	68-W-00-129
Prepared by	:	Tetra Tech EM Inc.
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U.S. EPA On-Scene Coordinator	:	Ken Theisen
Telephone No.	:	(312) 886-1959

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ABBREVIATIONS AND ACRONYMS

μg/L	Microgram per Liter
AOC	Area of concern
AOI	Area of interest
Bombardier	Bombardier Motor Corporation
CGI	Combustible gas indicator
DOT	Department of Transportation
FID	Flame ionization detector
FSP	Field sampling plan
HCL	Hydrochloric acid
HNO_3	Nitric acid
IDW	Investigation-derived waste
LBP	Lead-based paint
LNAPL	Light nonaqueous-phase liquid
MS/MSD	Matrix spike/matrix spike duplicate
OMC	Outboard Marine Corporation
OSC	On-Scene Coordinator
PA	Preliminary assessment
PCB	Polychlorinated biphenyl
PID	Photoionization detector
PLM	Polarized light microscopy
ppb	Part per billion
PPE	Personal protective equipment
ppm	Part per million
PUF	Polyurethane foam
QA	Quality assurance
QC	Quality control
RCRA	Resource Conservation and Recovery Act
SACM	Suspect asbestos containing material
SOP	Standard operating procedure
START	Superfund Technical Assessment and Response Team
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TCE	Trichloroethene
TechLaw	TechLaw, Inc.
Tetra Tech	Tetra Tech EM Inc.
TPH	Total petroleum hydrocarbons
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	Volatile organic compound
VSI	Visual Site Inspection

1.0 INTRODUCTION

The Tetra Tech EM Inc. (Tetra Tech) Superfund Technical Assessment and Response Team (START) prepared this field sampling plan (FSP) for the Outboard Marine Corporation (OMC) site in Waukegan, Lake County, Illinois under U.S. Environmental Protection Agency (U.S. EPA) Contract No. 68-W-00-129, Technical Direction Document No. S05-0202-004. The field sampling will be conducted as part of U.S. EPA discovery in the contested matter involving the Trustee's Motion for Approval of Abandonment of Real Property and Records Relating to Real Property dated November 1, 2001 in the OMC Chapter 7 Bankruptcy matter (Case No. 00-37405, Bankr. N.D. Ill.). This FSP describes multimedia sampling activities to be conducted during the field sampling. The FSP was developed based on (1) available data from previous OMC site investigations and (2) a site walkthrough conducted on 19 Feb 02.

The FSP consists of the following nine sections:

- Section 1.0 - Introduction
- Section 2.0 - Site Description and Background
- Section 3.0 - Project Summary
- Section 4.0 - Field Sampling Activities
- Section 5.0 - Decontamination Procedures
- Section 6.0 - Disposal of Investigation-Derived Waste (IDW)
- Section 7.0 - Sample Analytical Parameters
- Section 8.0 - Quality Assurance (QA)/Quality Control (QC) Procedures
- Section 9.0 - Reporting Requirements

References used to prepare this FSP are listed after Section 9.0. Appendix A to this FSP contains site maps and Appendix B contains applicable Tetra Tech standard operating procedures (SOP) to be followed during field sampling activities.

2.0 SITE DESCRIPTION AND BACKGROUND

This section briefly describes the OMC site, provides site background information, and discusses areas of interest (AOI) at the site.

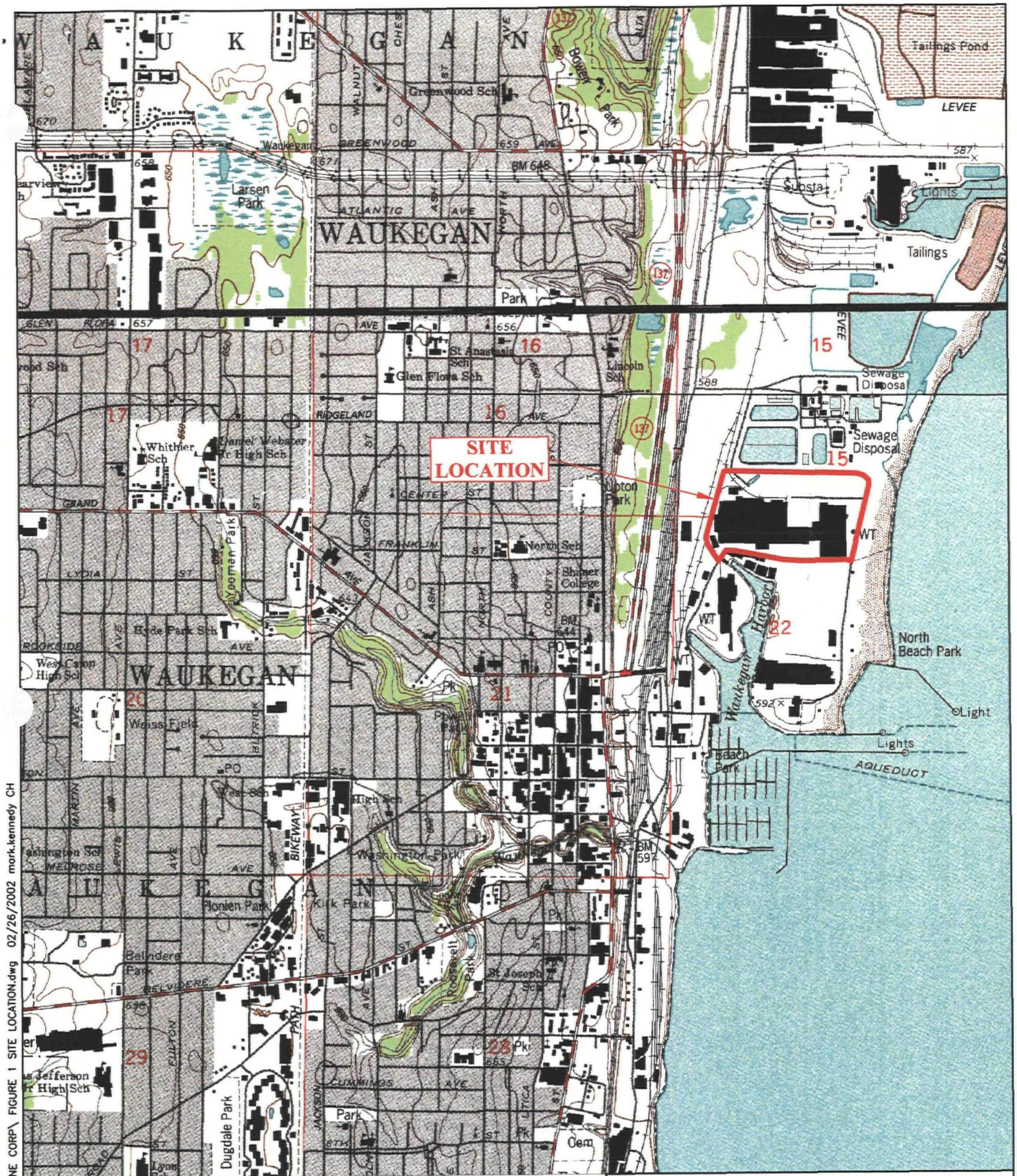
2.1 SITE LOCATION AND DESCRIPTION

The 124-acre OMC site is located near 200 Sea Horse Drive (Plant 1 address) in Waukegan, Lake County, Illinois (Figure 1). The OMC site is bordered to the north by a ditch (North Ditch) and the North Shore Sanitary District plant; to the east by public beaches on Lake Michigan; to the south by Sea Horse Drive; and to the west by the Elgin, Joliet, and Eastern Railroad. South of Plant 2, between Sea Horse Drive and Plant 1, is the Waukegan Coke Plant Superfund Site (owned by OMC) and the National Gypsum Company (see Appendix A).

The OMC site consists of Plant 1, Plant 2, and various other buildings, as well as land surrounding the buildings (see Appendix A). In Dec 00, OMC filed under Chapter 11 for bankruptcy and ceased operations at Plant 2. Bombardier Motor Corporation (Bombardier) owns Plant 1 of the former OMC facility and bought the assets located in Plant 2. Bombardier currently maintains electricity to Plant 2 and maintains staff on site to scrap machinery and materials in the building. The Plant 2 building, which is the primary focus of the field sampling, is approximately 1,036,000 square feet in size and consists of several AOIs described in further detail in Section 2.3.

2.2 SITE BACKGROUND

The OMC facility was built in several different phases beginning in 1927 and ending around 1975. Plant 1 was used for manufacturing operations and office space. The manufacturing operations at Plant 1 included aluminum and cast iron machining, electro-less tin plating, electro deposition painting, wastewater treatment, final assembly of outboard motors and stern drive motors, spray painting, vapor degreasing with chlorinated solvents, chromate conversion coating, engine testing, die casting, and electroplating. Floor drains in Plant 1 discharged into the Waukegan Harbor until the late 1940s (TechLaw, Inc. [TechLaw] 2001). The wastewater treatment system in Plant 1 discharges into the North Shore Sanitary District



OUTBOARD MARINE CORPORATION
WAUKEGAN, LAKE COUNTY, ILLINOIS
S05-0202-004

FIGURE 1

SITE LOCATION MAP

Tetra Tech EM Inc.

N

0 1000 2000

SCALE IN FEET

ILLINOIS

QUADRANGLE LOCATION

SOURCE: MODIFIED FROM USGS, WAUKEGAN, ILLINOIS, QUADRANGLE, 1993 AND ZION, ILLINOIS-WISCONSIN, QUADRANGLE, 1993

G:\G\9009\L(...)-OUTBOARD MARINE CORP\ FIGURE 1 SITE LOCATION.dwg 02/26/2002 mark.kennedy CH sewer system. Bombardier, which now owns Plant 1, currently maintains offices and performs research and testing of their products in Plant 1.

Construction on the Plant 2 building did not begin until 1949. Plant 2 was used for manufacturing operations that included aluminum smelting and holding, aluminum die casting, aluminum machining, polishing and finishing, spray painting, assembly, parts washing, chromate conversion coating, and wastewater pretreatment (TechLaw 2001). Plant 2 contains two sets of pipe chases underneath the flooring on the eastern and western ends of Plant 2. Several drainage systems are present under the various plant operation areas; and some of the drains are reportedly plugged.

OMC used hydraulic fluid containing polychlorinated biphenyls (PCB) in its die casting operations from approximately 1961 to 1972. In the 1980s, PCB-contaminated sediment was discovered in Slip 3 of the Waukegan Harbor at concentrations of over 500 parts per million (ppm) PCBs. The PCB-containing hydraulic fluids reportedly discharged through the floor drain system to the North Ditch and Slip 3 of the Waukegan Harbor. From 1989 to 1995, remedial activities included hydraulic dredging of the North Ditch and Waukegan Harbor (Slip 3 and surrounding areas); thermal treatment of the sediments; and placement of the treated sediments into three on-site containment cells - the East Cell, the West Cell, and Former Slip 3. Each containment cell has an extraction well system to maintain an inward hydraulic gradient. Post-closure groundwater monitoring of PCBs indicated that concentrations have been below detection except in Apr 00, when samples from monitoring well MW-10 exhibited a PCB concentration of 1.7 parts per billion (ppb).

TechLaw performed a preliminary assessment (PA) and conducted a Visual Site Inspection (VSI) in Jul 01 at the OMC facility. During the VSI, TechLaw identified 20 solid waste management units (SWMU) and four areas of concern (AOC). A PA/VSI report was prepared by TechLaw and is the primary source of background information used in this FSP. The SWMUs and AOCs identified during the PA/VSI are discussed in Section 2.3 as they relate to the field investigation.

In Jul 01, the U.S. EPA, Region 5, Waste Pesticides and Toxics Division, performed a limited sampling investigation at the OMC facility in conjunction with the PA/VSI conducted by TechLaw. This investigation consisted of sampling (1) pipe chases under Plant 2, (2) monitoring wells north of Plant 2,

(3) stained soil near the railroad spur north of Plant 2, (4) liquid in a cistern/sewers located near the outdoor chip wringer area on the north side of Plant 2, (5) a trough of metal working fluid, and (6) residue in a former PCB tank containment (U.S. EPA 2001). Liquid in the pipe chases was found to contain PCBs at concentrations as high as 300 ppb. Samples from the monitoring wells contained dichloroethane (at concentrations ranging from nondetect to 860 micrograms per liter [μg/L]), dichloroethene (nondetect to 19,000 μg/L), trichloroethene (TCE, nondetect to 290 μg/L), and vinyl chloride (nondetect to 5,800 μg/L). Stained soil near the railroad spur contained PCBs at concentrations as high as 18.5 ppm. Oil in the cisterns in the chip wringing area contained PCBs at concentrations as high as 165 ppm and dichloroethene in water in the cisterns at concentrations as high as 160,000 μg/L; TCE at concentrations as high as 2,100 μg/L; and vinyl chloride at concentrations as high as 210 μg/L.

2.3 AREAS OF INTEREST

The AOIs for the field sampling were identified based on (1) available background information and (2) the site walkthrough conducted on 19 Feb 02. This section discusses the site AOIs with reference to the general sampling locations that are targeted for the field investigation. For consistency purposes, the SWMUs and AOCs identified in the last PA/VSI are included in parentheses after each AOI, where applicable.

Chemical Storage Building. The chemical storage building (SWMU 2) is located in the southwest corner of Plant 2. It is estimated that this building contains approximately nine 330-gallon totes, 300 55-gallon drums, and 50 small containers. The labeled totes contained corrosives (hydrofluoric acid, nitric acid, potassium hydroxide solution, and fluorosilicic acid). Many of the drums contained various oils. The drums, totes, and containers appeared to be in good condition. The types of samples expected to be collected in the chemical storage building include waste samples from drums and totes.

Pipe Chases. Pipe chases exist in the west end of Plant 2 in the old die cast area and the east end of Plant 2 in the new die cast area. The west end pipe chases (AOC A) under the "old" die cast area are a higher concern compared to the east end pipe chases. The pipes in the west end pipe chases pumped PCB-containing hydraulic oil to die cast machines until 1977, when the die cast machines were dismantled (U.S. EPA 2001). Standing water in accessible points at the west end pipe chases will be sampled.

Chip Wringer Area. The chip wringer area (SWMU 7) is located on the north side of the building. The machining process associated with the production of cast iron marine engine components used an oil-based lubricant that became mixed with metal chips. The oily chips, or turnings, would be conveyed or transported to one of two wringers where they would be placed in concrete pits and allowed to drain. The metal chips, which still contained an oil residue, were then stored in either one of two large steel hoppers located on the north side of Plant 2 or a concrete hopper located near Plant 1. One of the two large steel hoppers is still present today in the chip wringing area on the north side of Plant 2. As noted in Section 2.2, stained soil in this area is contaminated with PCBs and the liquid in the open drains or cisterns under the hopper is reportedly contaminated with PCBs and chlorinated solvents. In addition, an open fill pipe to a former TCE underground storage tank yielded a reading of over 61 ppm organic vapors on a photoionization detector (PID) during the 19 Feb 02 site walkthrough. The types of samples expected to be collected in the chip wringer area include soil samples and liquid from the open drains and cisterns in this area.

Spray Paint Booth. During the site walkthrough, a room containing approximately 20 drums located near the center of Plant 2, was identified as a former spray paint booth. PID readings taken in this room gave a reading of 300 ppm organic vapors, and 2,300 ppm organic vapors inside an open drum. This room contains drums of suspected flammable paint. Material in these drums will be sampled during the field sampling.

Leaking PCB Transformers. Several large transformers (each containing approximately 293 gallons of oil) suspected to contain PCB oil are located throughout Plant 2. A large number of these transformers are roof-mounted above the "new" die cast area at the east end of Plant 2 and several other transformers are located throughout the building. One leaking transformer was observed inside Plant 2 above a boiler room. Samples will be collected from at least one leaking transformer as directed by the OSC during the field sampling.

Groundwater North of Plant 2. Several monitoring wells are present surrounding the containment cells north of Plant 2 (see Appendix A). The groundwater from these wells is contaminated with chlorinated solvents. Wells W-6 and W-9 appear to contain the highest concentrations and are located on the east and west ends of the cells, respectively (see Appendix A). It is anticipated that a number of these wells will be sampled along with a well between the east and west cell, such as W-12, as directed by the OSC during the field sampling.

North Ditch. This drainage ditch was reportedly historically contaminated with PCBs. The water from this ditch mixes with a larger discharge from the North Shore Sanitary District wastewater treatment plant effluent. Sediment of the North Ditch will be sampled during the field sampling.

Water Treatment and Former Plating Area. A water treatment and former plating area is located in the center of Plant 2. Chrome plating and TCE recycling occurred in this area. A basement in this area contains troughs used for the chrome plating operations. These troughs contain a solid residue that will be sampled during the field sampling.

Other areas not identified above include the locations of asbestos, air, and wipe samples in Plant 2; scattered drums, pits, and tanks throughout Plant 2; floor drains; and soil samples around the perimeter of Plant 2. All sample locations, except possibly the asbestos sample locations, will be determined on the first day of field sampling during the site walkthrough. Interested parties will be notified of all sample locations, except possibly the asbestos locations, following the site reconnaissance on the first day of the field investigation.

3.0 PROJECT SUMMARY

This section summarizes the project's objective, scope of work, and tentative schedule.

3.1 OBJECTIVE

The objective of the field sampling at the OMC site is to identify wastes, soil, sediment, groundwater, and oil at the site pursuant to U.S. EPA's discovery request in the contested matter involving the Trustee's Motion for Approval of Abandonment of Real Property and Records Relating to Real Property dated November 1, 2001 in the OMC Chapter 7 Bankruptcy matter (Case No. 00-37405, Bankr. N.D. Ill.). In addition, it is the objective of the field sampling at the OMC facility to estimate the volume of wastes, by type, present at Plant 2.

3.2 SCOPE OF WORK

The scope of work for the project consists of those tasks necessary to achieve the objective described in Section 3.1. This objective will be accomplished by collecting samples from various media at the AOIs described in Section 2.3; collecting soil samples around the perimeter of Plant 2; collecting various samples from miscellaneous drums, pits, containers, and drainage systems throughout Plant 2; collecting insulation samples for asbestos analysis; and conducting an inventory of wastes. In addition, air sampling in Plant 2 and wipe sampling of machinery will be conducted to assess any risks to human health inside the building. Sections 4.0 through 8.0 of this FSP provide specific details.

3.3 TENTATIVE SCHEDULE

Table 1 presents a tentative schedule for the project.

TABLE 1

TENTATIVE PROJECT SCHEDULE

Activity	Tentative Due Date
Site setup and initial site walkthrough to identify all sampling locations	04 Mar 02
Conduct sampling activities	05 Mar 02
Conduct inventory of wastes and complete sampling if necessary	06 Mar 02
Receive verbal analytical results	15 Mar 02
Receive hard copy analytical results	20 Mar 02
Submit report with validated analytical results to U.S. EPA OSC	01 Apr 02

Notes:

OSC = On-Scene Coordinator
U.S. EPA = U. S. Environmental Protection Agency

4.0 FIELD SAMPLING ACTIVITIES

This section provides details regarding field sampling activities for the OMC site. Specifically, the text discusses sampling rationales, locations, depth intervals, equipment, and procedures; sample handling procedures; and laboratory analytical parameters associated with the proposed soil, sediment, groundwater, waste, air, wipe, and asbestos sampling at the OMC site. All sampling locations will be selected by the U.S. EPA OSC and START on the first day of the field investigation. Two to three Tetra Tech personnel are expected to be present for a walkthrough on the first day in addition to one person who will deliver and set up necessary sampling equipment.

Tetra Tech anticipates maintaining nine people on site for sampling activities on the second day of the field sampling. A team of two people will perform air, wipe, and miscellaneous sampling throughout Plant 2; a team of three people will perform waste sampling; a team of two people will perform the outdoor sampling; one person will perform sample management; and one more person will serve as the project manager coordinating all sampling activities.

On the third day of the field sampling, Tetra Tech anticipates maintaining six to seven personnel on site. Two teams of two people will perform an inventory of all waste containers on this day. In addition, the project manager and a Tetra Tech licensed asbestos inspector will perform the asbestos sampling in Plant 2. A seventh person may be necessary for cleanup and the shipping of equipment off site. If sampling is not completed on the second day, it may be necessary to staff additional personnel to complete the sampling on this day; therefore, as many as nine personnel may be on site on day three of the field sampling.

At the request of the U.S. EPA OSC, Tetra Tech will not collect any split samples for other interested parties during the field sampling. Any parties wishing to collect samples at the same sampling locations as Tetra Tech may do so but will need to supply their own personnel and sampling equipment. In addition, the logistics as to how many teams are sampling at one time may be changed based on discussions between the U.S. EPA and interested parties.

All field activities will be conducted in accordance with this FSP and applicable Tetra Tech SOPs, which are included in Appendix B to this FSP. When the FSP differs from the SOPs, site-specific FSP procedures will be followed. Any deviations from the FSP will be approved by the U.S. EPA OSC before their implementation and will be documented in the final field sampling report.

4.1 SOIL SAMPLING

Tetra Tech anticipates collecting soil samples in the chip wringer area and possibly around the perimeter of Plant 2. The sampling locations will be determined in the field during START reconnaissance site activities during the first day of the field investigation. Interested parties will be notified of all sample locations following the site reconnaissance on the first day of the field investigation. Samples will be collected in accordance with Tetra Tech SOPs 005 and 044 (see Appendix B) except where they differ with the procedures discussed below.

Soil samples will be collected at a depth of 0 to 12 inches using a stainless steel spoon, trowel, or auger as warranted. The samples will be placed in a disposable aluminum foil pan and homogenized by stirring thoroughly. Appropriate sample jars will then be filled.

If soil samples are to be collected for volatile organic compound (VOC) analysis, these samples will be collected first, prior to any sample homogenization. The top layer of soil on the ground will first be scraped away with a stainless steel trowel or spoon, and an EnCore sample will then be used to collect three 5-gram EnCore samples.

Qualitative observations regarding each soil sample's color, composition (sand, silt, and clay), and water content (if any) will be recorded. The sample's composition will be qualitatively evaluated by visual observation and by rubbing a small bit of the soil between gloved fingers to assess its sand, silt, and clay consistency. At each subsurface soil sampling location, the soil will be logged in accordance with the Unified Soil Classification System.

Soil samples will be submitted to a subcontracted laboratory for analyses. The exact analyses for each soil sample will be determined in the field on the first day of the field investigation. It is expected that soil samples may be analyzed for VOCs, PCBs, and Resource Conservation and Recovery Act (RCRA) metals.

4.2 SEDIMENT SAMPLING

START will collect approximately three sediment samples in the North Ditch. The exact sampling locations will be confirmed in the field during START reconnaissance site activities on the first day of the field investigation. Wherever possible, sampling crews will collect samples from downstream locations first and will approach the sampling locations from downstream to minimize sediment disturbance. The sediment sampling locations are located along the ditch bank adjacent to the site; therefore, samples may be collected from the shore or by wading into the ditch close to the shore.

During sampling, all START observations and measurements (including the water depth and the depth of sampler descent at each sampling location) will be recorded in a field logbook. The sediment sampling device will then be hauled to the surface.

Procedures that will be used to characterize and prepare the sediment samples collected with grab and core samplers are described below.

1. START will transfer the sediment from the grab sampler into a sample container and allow the sediment to settle.

2. START will pour any water overlying the sediment into the ditch by tipping the container. Care will be taken to retain the fine sediment fraction during this step.

3. START will record qualitative observations regarding the sediment sample's color, composition (sand, silt, and clay), and water content (low versus high). The sample's composition will be qualitatively evaluated by visual observation and by rubbing a bit of sediment between gloved fingers to estimate the sand, silt, and clay content.

4. START will remove unrepresentative material from the sample, which may include sticks, shells, and stones.

5. START will immediately fill the sample containers for VOC analysis using EnCore samplers. Three 5-gram EnCore aliquots will be collected.

6. After all sample containers for VOC analysis are filled, START will homogenize the remaining sediment by stirring it in a stainless-steel bowl using a stainless-steel spoon until the sediment attains uniform color, texture, and residual water distribution. The amount of sample homogenized for each sampling location will be based on analytical method sample volume requirements. Each sample container will be filled with a stainless-steel spoon.

Sediment samples will be submitted to a subcontracted laboratory for analyses. The exact analyses for each sediment sample will be determined in the field on the first day of the field investigation. It is expected that sediment samples may be analyzed for VOCs, semivolatile organic compounds (SVOC), PCBs, and RCRA metals.

4.3 GROUNDWATER SAMPLING

Tetra Tech will collect groundwater samples from three of the monitoring wells located north of Plant 2 (MW-6, MW-9, and MW-12). Prior to groundwater sampling activities, water levels will be measured and the presence of light nonaqueous-phase liquid (LNAPL) will be checked in all on-site monitoring wells.

Tetra Tech will check for the presence of LNAPL visually using a dedicated bailer at each monitoring well. If a sufficient amount of LNAPL is encountered during groundwater sampling, and if the LNAPL is present in the form of a distinct layer that can be separated from the groundwater, LNAPL samples will be collected and analyzed by a subcontracted laboratory. The exact analyses for the LNAPL will be determined during the field investigation. It is expected that LNAPL will be analyzed for VOCs, SVOCs, RCRA metals, and PCBs.

Groundwater samples will be collected from the wells using a dedicated bailer at each monitoring well. The samples will be collected directly from the bailer and placed in appropriate sample containers. The monitoring wells will not be purged prior to sampling. Groundwater samples will be submitted to a subcontracted laboratory for analyses. The exact analyses for the groundwater samples will be determined in the field on the first day of the field investigation. It is expected that groundwater samples may be analyzed for VOCs, SVOCs, and PCBs.

4.4 WASTE MATERIALS SAMPLING

Numerous drums, tanks, totes, vats, pits, and pipe chases containing unknown waste materials are located in the hazardous materials storage room and throughout Plant 2. The waste materials include solid, semisolid, oil, and liquid materials. Tetra Tech will collect approximately 20 waste material samples throughout the site. Waste materials will be sampled in accordance with the following sampling protocols documented in the SOPs presented in the Appendix B.

- No. 003 - Organic Vapor Air Monitoring
- No. 006 - Sludge and Sediment Sampling
- No. 007 - Bulk Materials Sampling
- No. 008 - Containerized Liquid, Sludge, and Slurry Sampling

Specific task requirements are discussed below.

- All drums will be sampled using level B personal protective equipment (PPE) and air monitoring will be performed with a PID/flame ionization detector (FID) and combustible gas indicator (CGI).

- The tote containing hydrofluoric acid will be sampled in modified level B PPE with fully encapsulated suits; hydrofluoric acid Draeger tubes will be used to check for the presence of hazardous vapors.

- Air monitoring will be performed on all open containers (vats, pits, pipe chases) in level C PPE with the PID/FID and CGI; if the atmosphere is not more than five times background levels, waste material sampling will be conducted in level D PPE.

Waste samples will be submitted to a subcontracted laboratory for analyses. The exact analyses for the waste samples will be determined in the field on the first day of the field investigation. It is expected that waste samples will be analyzed for VOCs, SVOCs, PCBs, RCRA metals, total petroleum hydrocarbons (TPH), ignitability, pH, and total cyanide.

In addition, START will prepare an inventory of the approximate volumes of each type of waste material, including 5-gallon pails. Containers smaller than 5 gallons will be identified but not inventoried.

4.5 AIR SAMPLING

Air quality monitoring will occur as part of the OMC field sampling. VOCs and PCBs are proposed to be sampled in ambient air and analyzed. VOCs will be sampled through the use of summa canisters and analyzed by gas chromatography following EPA Method TO-14A (U.S. EPA 1999a), and Tetra Tech's SOP 073, as applicable. Integrated 8-hour sampling using 6-liter stainless steel summa canisters equipped with control valves will be used. The air flow and vacuum will be checked periodically during sampling. The number of VOC air sampling locations will be determined in the field during the first day of field activities. It is expected that three to five canisters will be used for ambient air VOC sampling. A VOC background sample will not be collected as part of this field sampling. A blank VOC air sample will be analyzed along with the investigative samples.

PCBs will be sampled and analyzed following sampling and analysis procedures contained in EPA Method TO-10A (U.S. EPA 1999b), and Tetra Tech's SOP 073, as applicable. Portable air sampling pumps will be set at an air flow of 2 to 5 liters per minute, depending on the reporting limit expected to be achieved. The polyurethane foam (PUF) cartridges will be connected to the air sampling pump with new plastic tygon tubing. The PUFs will be set at an elevation that is 4 to 8 feet above the floor, or as directed by the U.S. EPA OSC. The air sampling pumps will run for at least 8 hours at a constant air flow, which will be verified and recorded before and after the sampling period. The number and location of PCB air sampling stations will be determined in the field during the first day of sampling. It is expected that up to six PCB air sampling stations will be setup. Most of these locations will be at specific former manufacturing areas where historical records indicate that PCB-containing oil and materials were used at Plant 2.

One blank PUF cartridge will be sent for analysis for QC purposes. Background PCB ambient air samples will not be collected as part of this field sampling.

4.6 WIPE SAMPLING

Oils containing PCBs were used at the OMC facility at manufacturing areas and were stored in various aboveground storage tanks. The use of hydraulic oils appeared to be extensive at specific manufacturing areas within Plant 2. Given the manufacturing activities performed and the time at which Plant 2 was originally built, metallic dust could have been generated at manufacturing areas, and lead-based paint (LBP) could have been used extensively throughout Plant 2. Wipe samples are proposed to be collected at specific manufacturing and storage areas where PCB-containing oil was used at Plant 2. This section describes the protocols to use to collect wipe samples for PCBs and metallic dust on flat surfaces.

PCB Wipe Samples

PCB wipe samples are proposed to be collected following the wipe sampling recommended in the revised U.S. EPA protocols (U.S. EPA 1991). PCB wipe samples are proposed to be collected at locations where manufacturing activities suggest that PCBs-containing oils and materials were used.

Wipe samples for PCBs will be collected on flat surfaces at predetermined sampling locations. Adequate numbers of 4-once clean glass containers with teflon caps containing 2-inch by 2-inch sterile cotton gauze (Curity™, Johnson & Johnson™, or equivalent) soaked with hexane will be used. Sample pads may also be ashless quantitative filter paper. New disposable latex or nitrile gloves compatible with hexane will be used each time a wipe sample is collected to minimize cross-contamination of wipe samples. A 10-centimeter by 10-centimeter cardboard template will be used to limit the sampling area to 100 square centimeters, consistent with standard sampling area requirements. Before sampling, the area to sample will be identified and a 10-centimeter by 10-centimeter cardboard template will be placed showing the square area to sample. Two sampling personnel will be necessary to minimize cross-contamination of samples and sample bottles. As one sampler opens the 4-ounce glass container, the second sampler will insert his/her gloved fingers inside the glass container using new disposable gloves to retrieve the cotton gauze and squeeze the excess hexane. The cotton gauze will be squeezed to let any free hexane drip back into the glass container using doubly gloved hands ensuring that free hexane is not in excess to minimize loss of sample caused by dripping hexane. The sampler will then exert a consistent pressure against the area being sampled, and will perform the wiping from left to right in rows and from top to bottom of the framed sampling area, ensuring that the sampling template is not displaced. Once the bottom of the sampling area is reached, the cotton gauze will be folded and the area will be wiped from top to bottom in the left to right direction ensuring that each point within the area being sampled has been wiped at least twice. The wiping procedure will be as systematic and consistent as possible.

The pad will be folded once more and inserted in the open glass container allowing the gauze pad to air dry and any residual solvent in the glass container to evaporate. The sample container will be closed and the lid tightened. The sample container will be labeled using a systematic sample identification system, and the sample chain-of-custody form will be completed. The sample will then be taken to the sample processing area where the sample will be logged, securely packed, and readied for shipment.

Trip blanks and equipment blanks will be prepared each day of PCB wipe sampling. Trip blanks are sample containers that contained the cotton gauze and hexane and are not opened. Equipment blank samples are cotton gauzes that are taken out of the sampling container using clean latex or nitrile gloves, squeezed to release excess solvent, stroked against clean cardboard templates, and allowed to air dry before they are inserted into the original sample container.

All disposable sampling equipment will be discarded and placed in trash bags that will be kept for future disposal as IDW.

Lead-Based Paint and Metallic Dust Wipe Samples

Wipe samples for LBP and metallic dust will be collected on flat surfaces at predetermined sampling locations following the National Institute for Occupational Safety and Health Manual of Analytical Methods, Fourth Edition, 15 Aug 94. Adequate numbers of 4-ounce glass jars will be used. Sample pads consist of 2-inch by 2-inch sterile cotton gauze (Curity™, Johnson & Johnson™, or equivalent), or ashless quantitative filter paper. New disposable latex or nitrile gloves will be used each time a wipe sample is collected to minimize cross-contamination of wipe samples. A 10-centimeter by 10-centimeter cardboard template will be used to limit the sampling area to 100 square centimeters, consistent with standard sampling area requirements. A plastic squeeze bottle containing distilled water will be used to moisten the cotton gauze (or equivalent sampling material) before sampling, ensuring that water is not in excess to minimize loss of sample caused by dripping water. Only the central area of the gauze pad will be moistened. Pre-moistened gauze pads may be used (Wash'n Dri™) and distilled water will not be necessary.

The 10-centimeter by 10-centimeter template will be placed over the area to be sampled. The sample will be collected by wiping the surface to be sampled with firm pressure, using three to four vertical S-strokes and folding the exposed side of the pad in and wiping the area with three to four horizontal S-strokes. The pad will be folded once more and wiping the area with three to four additional vertical S-strokes. The gauze pad will be folded with the exposed side in, and placed in the clean 4-ounce glass jar. The sample container will be sealed and labeled clearly in accordance with the sample labeling protocol described below in this FSP. New templates will be used at each sampling location to ensure that cross-contamination of samples is minimized.

All disposable sampling equipment will be discarded and placed in trash bags that will be disposed as IDW.

Trip blanks will not be necessary for LBP and lead dust sampling. One equipment blank sample will be prepared by moistening a cotton gauze with distilled water, squeezing excess water using gloved hands and placing the gauze in the 4-ounce jar.

Alternate wipe sampling equipment includes:

- Smear tabs (part no. 225-24, SKC Inc., Eighty Four, PA), or wipe filters (Whatman no. 41 or no. 42 filters, Whatman Labsales Inc., Hillsboro, OR).
- Scintillation vials, 20-milliliter (part no. 74515 or 58515, Kimble, Div. of Owens-Illinois Inc., Toledo, OH) with polypropylene or Teflon cap liners. Metal cap liners should not be used.

4.7 ASBESTOS SAMPLING

Tetra Tech will send an accredited asbestos inspector who is familiar with the Asbestos Hazard Emergency Response Act (U.S. EPA 1987) inspection protocol to perform the survey. The inspector will identify and sample suspect asbestos-containing materials (SACM) on both the interior and exterior of the structures at the facility. Material locations, type, and approximate quantity of SACM will be noted during the survey. Photographs will be taken of each SACM. Samples will be submitted for laboratory analysis using polarized light microscopy (PLM) and dispersion staining in accordance with U.S. EPA Test Method 600/M4-82-020, to determine if the material contains asbestos.

5.0 DECONTAMINATION PROCEDURES

Sampling equipment will be decontaminated on plastic liners at each sampling location. Nondedicated sampling equipment will be decontaminated after each sample is collected. This decontamination may include disassembling the equipment and washing it with Alconox soap and water solution. In general, decontamination will consist of removing all visible evidence of contamination using a brush, washing the equipment with an Alconox soap and water solution, and applying three distilled water rinses. The decontaminated equipment will then be allowed to air-dry. Decontamination procedures are discussed in detail in Tetra Tech SOP No. 002 (see Appendix B). Disposable equipment such as plastic tubing, coveralls, gloves, and boot covers will be used wherever possible to minimize the possibility of cross-contamination.

All decontamination fluids will be collected, placed in appropriate U.S. Department of Transportation (DOT) containers, and retained as IDW. The drums will be secured and temporarily stored on site, as directed by the U.S. EPA OSC pending receipt of IDW sample analytical results.

6.0 DISPOSAL OF INVESTIGATION-DERIVED WASTE

START will segregate and store liquid and solid IDW during the field sampling effort. START anticipates collecting one liquid IDW composite sample, if liquid IDW was generated during sampling activities, and one solid IDW composite sample at the completion of field sampling. The composite samples will be analyzed by a subcontracted laboratory for VOCs, SVOCs, PCBs, toxicity characteristic leaching procedure (TCLP) metals, ignitability, and corrosivity. After receiving analytical results for the IDW composite samples, START will direct a waste disposal subcontractor to dispose of the IDW in accordance with local, state, and federal regulations.

7.0 SAMPLE ANALYTICAL PARAMETERS

Section 4.0 indicated the analyses expected to be performed on the various matrices. Note that these analytical parameters may be altered in the field as conditions and the nature of the sample warrant. Table 2 summarizes the sample analytical parameters for the project along with the analytical methods and sample containers.

8.0 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

This section discusses QC samples, sample identification, QC of field activities, sample documentation and management, and data validation.

8.1 QUALITY CONTROL SAMPLES

Trip blanks are used to assess the potential for sample contamination during handling, shipment, and storage. Trip blanks are sample bottles filled with organic-free water. The trip blanks are sealed and transported to the field; kept with empty sample bottles and then with the investigative samples throughout the field effort; and returned to the laboratory for analysis with the investigative samples. Trip blanks are

TABLE 2
SUMMARY OF SAMPLE ANALYTICAL PARAMETERS, METHODS, AND CONTAINERS

Analyte	Analytical Method	Matrix	Sample Container	Preservation	Holding Time
Metals	SW-846 6010B and 7000 series	Soil, sediment, and waste	4-ounce, clear, wide-mouth jar	Cool to 4°C	6 months (28 days for mercury)
		Groundwater	1-liter polyurethane bottle	HNO_3 to pH<2 and cool to 4°C	6 months (28 days for mercury)
Lead	SW-846 6010B	Wipe	4-ounce glass jar	Cool to 4°C	6 months
VOCs	SW-846 8260B	Soil and sediment	Two 5-gram and One 25-gram EnCore	Cool to 4°C	14 days
		Waste	4-ounce, clear, wide-mouth jar	Cool to 4°C	14 days
		Water	Two 40-milliliter vials per sample	HCl to pH<2 and cool to 4°C	14 days
	TO-14A	Air	Summa Cannister	None	30 days
SVOCs	SW-846 8270C	Sediment and waste	4-ounce, clear, wide-mouth jar	Cool to 4°C	14 days to extract, 40 days to analyze
		Groundwater	1-liter amber bottle	Cool to 4°C	14 days to extract, 40 days to analyze
PCBs	SW-846 8082	Soil, sediment, waste, and wipe	4-ounce glass jar	Cool to 4°C	14 days to extract, 40 days to analyze
		Groundwater	1-liter amber bottle	Cool to 4°C	7 days to extract, 40 days to analyze
	TO-10A	Air	PUF cartridge	Cool to 4°C	7 days to extract, 40 days to analyze
TPH	SW-846 8015	Waste oils	4-ounce, clear, wide-mouth jar	Cool to 4°C	14 days
Ignitability	SW-846 1010 or 1020A	Waste	2-ounce, clear, wide-mouth jar	Cool to 4°C	None
pH	SW-846 9045C/9040B	Waste	2-ounce, clear, wide-mouth jar	Cool to 4°C	None
Cyanide	SW-846 9010B or 9012A	Waste	2-ounce, clear, wide-mouth jar	Cool to 4°C	14 days

TABLE 2 (continued)
SUMMARY OF SAMPLE ANALYTICAL PARAMETERS, METHODS, AND CONTAINERS

Analyte	Analytical Method	Matrix	Sample Container	Preservation	Holding Time
SACM	PLM by U.S. EPA Test Method 600/M-4-82-020	Solid	Plastic bag	None	None

Notes:

HNO_3	=	Nitric acid
HCl	=	Hydrochloric acid
PCB	=	Polychlorinated biphenyl
PLM	=	Polarized light microscopy
PUF	=	Polyurethane foam
SVOC	=	Semivolatile organic compound
TPH	=	Total petroleum hydrocarbons
U.S. EPA	=	U.S. Environmental Protection Agency
VOC	=	Volatile organic compound
SACM	=	Suspect asbestos containing material
SW-846	=	Solid waste method

never opened in the field. One trip blank will be included in every shipping cooler of liquid samples to be analyzed for VOCs.

Field blanks are samples of a matrix that is the same or similar to that of actual investigative samples. Field blanks are exposed to the sampling environment or equipment at the time of sampling. They are used to assess contamination resulting from ambient conditions. Field blanks are required for liquid matrices. For aqueous samples, field blanks will consist of deionized or demineralized water. Field blanks are generally not required for solid matrices but may be collected on a case-by-case basis. One field blank will be collected for every 10 or fewer liquid investigative samples.

Equipment rinsate blanks are collected when sampling equipment is used to transfer samples into containers. These blanks are used to assess the cleanliness of the sampling equipment and the effectiveness of equipment decontamination. Equipment rinsate blanks are collected by pouring analyte-free water over the surfaces of sampling equipment that contact sample media. Equipment rinsate blanks are collected after sampling equipment has been decontaminated but before it is reused for sampling. Equipment rinsate blanks are typically collected at a frequency of one for every 10 or fewer liquid investigative samples. Equipment rinsate blanks are not usually required for solid matrices but will be collected at a frequency of one for every 10 or fewer investigative samples. Equipment rinsate blanks will not be collected for dedicated equipment used to collect samples.

A field duplicate sample is an independent sample collected as close as possible in space and time to the original investigative sample. Immediately following collection of the original sample, the field duplicate sample is collected using the same collection method. Care will be taken to collect the field duplicate sample as close to the original sampling location as possible. Field duplicate samples can be used to measure how sampling and other field procedures influence the precision of an environmental measurement. They can also provide information on the heterogeneity of the sample matrix at a sampling location. Field duplicates are collected at a frequency of one for every 10 investigative samples of the same matrix type.

Matrix spike and matrix spike duplicate (MS/MSD) samples are typically collected for analysis by organic methods. Solid and waste MS/MSD samples require no extra volume. Each liquid MS/MSD sample is a single sample, usually collected from a single location at triple the normal sample volume for VOC analysis and double the normal volume for extractable organic analysis. MS samples are typically collected for analysis by inorganic methods. Each MS sample is a single sample, usually collected from a single location at double the normal sample volume. In the laboratory, MS/MSD samples and MS samples are split and spiked with known amounts of analytes. Analytical results for MS/MSDs are used to measure the precision and accuracy of the laboratory organic analytical program; results for MSs are used to measure the accuracy of the inorganic analytical program. Each of these QC samples will be collected and analyzed at a frequency of one for every 20 investigative samples from a matrix.

8.2 SAMPLE IDENTIFICATION

Each sample will be identified using an alphanumeric system that identifies the project, sample type, and sampling location, and sampling depth (if applicable). The following designations will be used to identify sample types:

- "AIR" for an air sample
- "BLK" for a field blank sample
- "DUP" for a field duplicate sample
- "ER" for an equipment rinsate sample
- "IDW" for an IDW composite sample
- "INS" for an insulation sample
- "MW" for a groundwater sample from a monitoring well
- "SD" for a sediment sample
- "SS" for a soil sample
- "TB" for a trip blank

- "WASTE" for a waste sample
- "WIPE" for a wipe sample

Each predetermined sampling location will have a specific designation. Matrix spike/matrix spike duplicate samples will be identified in the field logbook and will be clearly designated on the chain-of-custody forms rather than in the sample identification numbers. Examples of sample identification numbers are listed below.

- WASTE-05 — Waste sample from location 05
- AIR-03 — Air sample from location 03
- WASTE-DUP-01 — First field duplicate waste sample collected (duplicate location to be documented in field logbook)

8.3 QUALITY CONTROL OF FIELD ACTIVITIES

The START project manager will be responsible for ensuring that sample quality and integrity are maintained in accordance with Tetra Tech's QA Program Plan for START (Tetra Tech 2000) and that sample labeling and documentation are performed as described in Section 8.2 of this plan.

8.4 SAMPLE DOCUMENTATION AND MANAGEMENT

All sample documents will be completed legibly and in ink. Any document correction or revision will be made by lining through the original entry and initialing the change (see SOP 024 in Appendix B). Documentation procedures for the field logbook, sample labels, chain-of-custody records, and custody seals are described below. Samples will be shipped in accordance with Tetra Tech SOP 019 (see Appendix B).

Field Logbook: The field logbook details field activities and observations in an accurate and factual manner. The individual making logbook entries will sign each entry. Entries will include the following information:

- Site name and project number
- Names of personnel
- Dates and times of all entries
- Descriptions of all activities as well as off-site entry and exit times
- Noteworthy events and discussions
- Weather conditions
- Site observations
- Identification and descriptions of samples and sampling locations
- Dates and times of sample collection
- Records of photographs
- Site sketches
- Deviations from applicable U.S. EPA approved guidance or documents

Sample Label: A sample label will be attached to each sample container. The sample label will include the following information at a minimum:

- Sample identification number
- Sample collection date and time
- Name of sampler
- Sample preservative
- Requested sample analyses

Chain-of-Custody Record: A chain-of-custody record will be maintained from the time of sample collection until the sample's final disposition. Every transfer of sample custody will be noted and signed for on the record, and a copy of the record will be kept by each individual who has signed it. The chain-of-custody record will include the following information at a minimum:

- Sample identification number
- Sampling location
- Sample collection date
- Sample information
- Names and signatures of samplers
- Signatures of all individuals who have had custody of the sample

Custody Seals: Custody seals will be used on each shipping container to confirm that samples have not been disturbed. The individual who has custody of the samples will sign and date the seals and affix them to the shipping container so that the container cannot be opened without breaking the seals.

8.5 DATA VALIDATION

START will perform data validation of the sample analytical results in accordance with U.S. EPA's "Contract Laboratory Program National Functional Guidelines for Organic Data Review" (U.S. EPA 1999c) and "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (U.S. EPA 1994).

9.0 REPORTING REQUIREMENTS

Validated sample analytical results and other information gathered will be summarized in a field sampling report. The field sampling report will be submitted to the OSC upon completion.

REFERENCES

National Institute for Occupational Safety and Health. 1994. "Manual of Analytical Methods," Fourth Edition, August 15.

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U.S. EPA. 1987. Asbestos Hazard and Emergency Response Act Regulations. 40 *Code of Federal Regulations* Part 763. U.S. EPA "Asbestos Materials in Schools." October.

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U.S. EPA. 1996. "Test Methods for Evaluating Solid Waste." SW-846, Third Edition, Final Update III. Office of Solid Waste and Emergency Response. Washington, DC. December.

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U.S. EPA. 1999b. "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium TO-10A. Determination of Pesticides and Polychlorinated Biphenyls in Ambient Air Using Low Volume Polyurethane Foam (PUF) Sampling Followed By Gas Chromatographic/Multi-Detector Detection (GC/MD)." EPA/625/R-96/010b. January.

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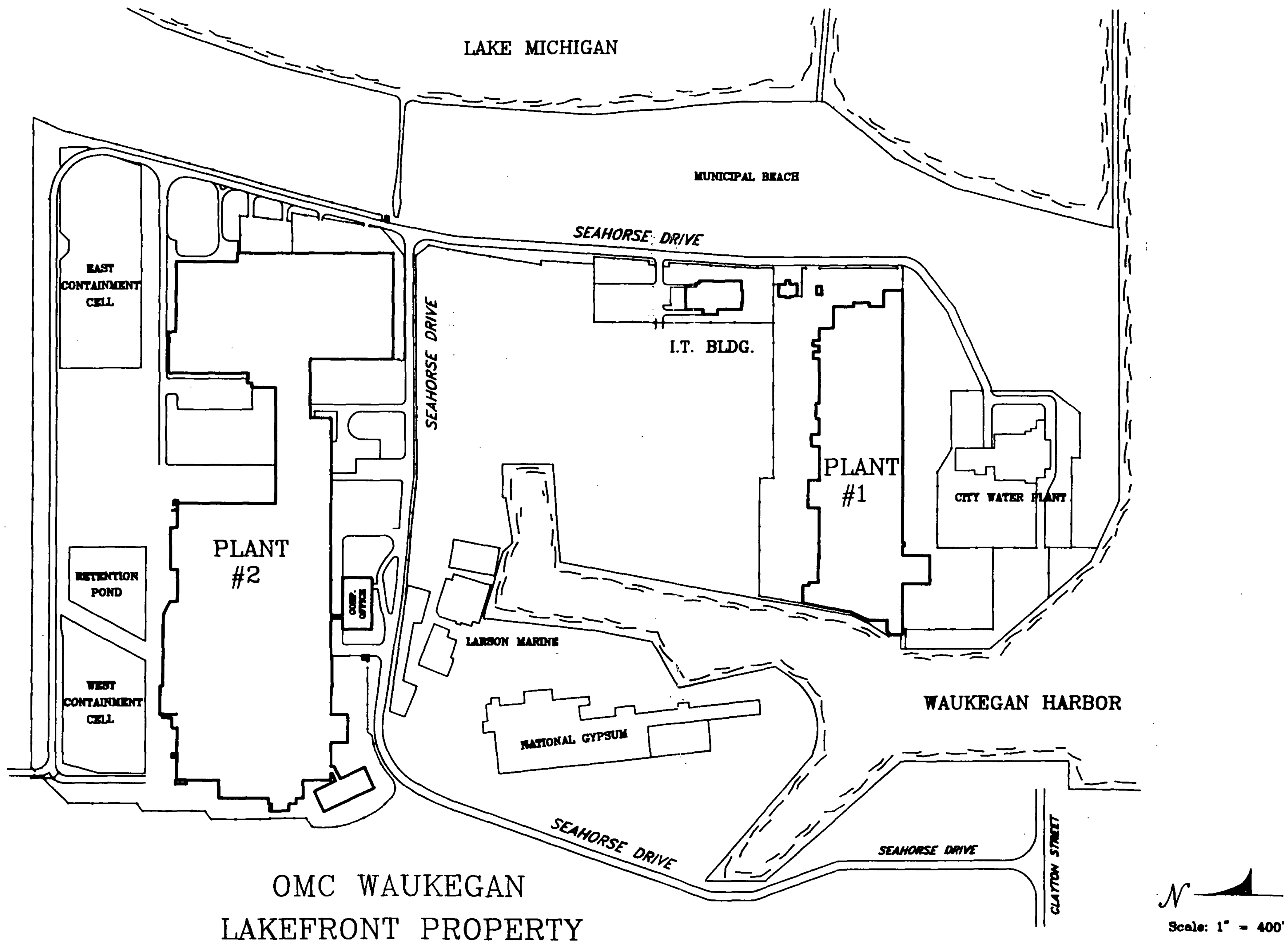
USGS. 1993b. 7.5-Minute Series Topographic Map of Zion, Illinois-Wisconsin, Quadrangle.

A

APPENDIX A

OUTBOARD MARINE CORPORATION FACILITY MAPS

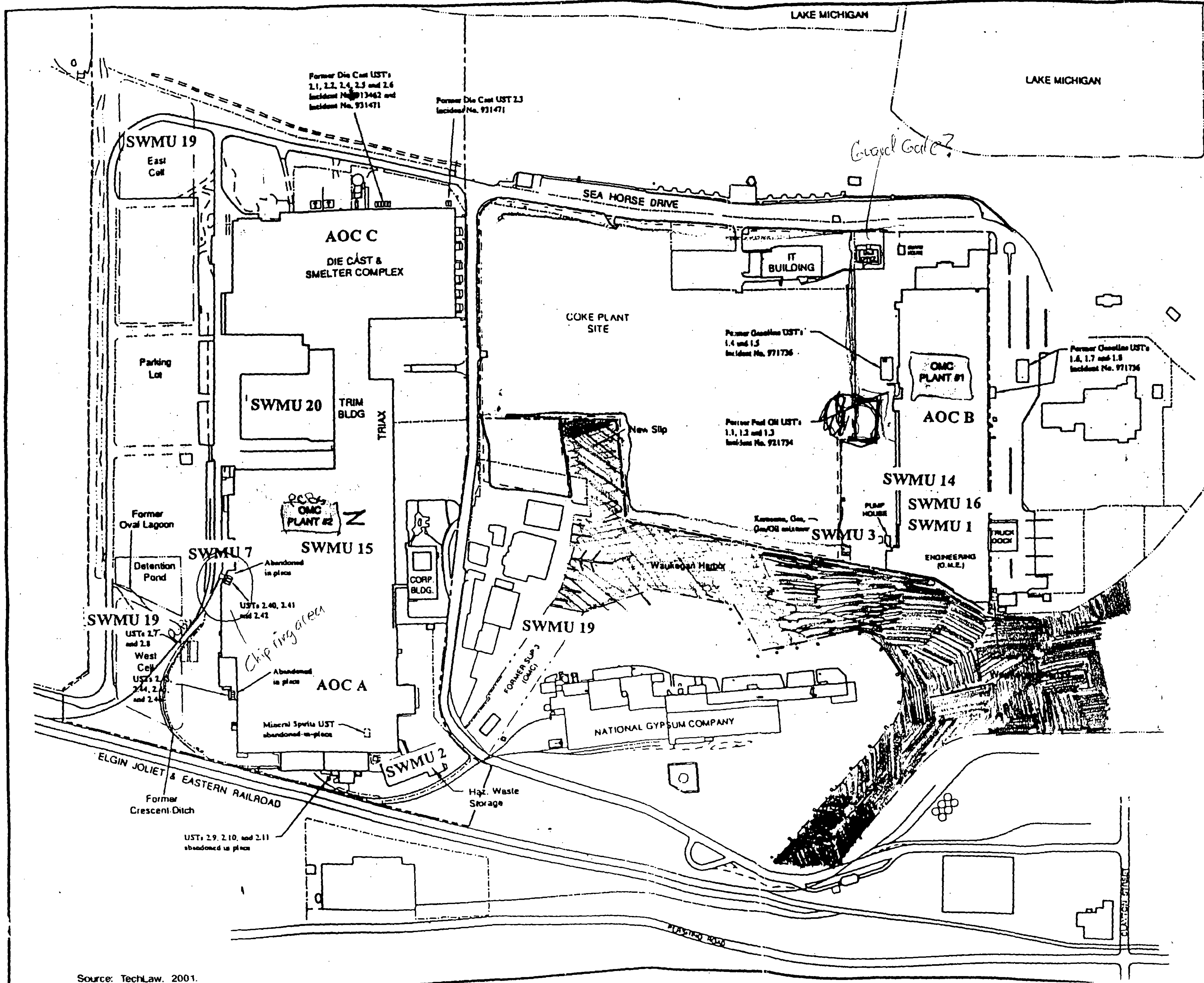
(Three Sheets)



OMC WAUKEGAN
LAKEFRONT PROPERTY

Source: Outboard Marine Corporation. 2002.

FACILITY LAYOUT AND SWMU/AOC LOCATIONS



NORTH

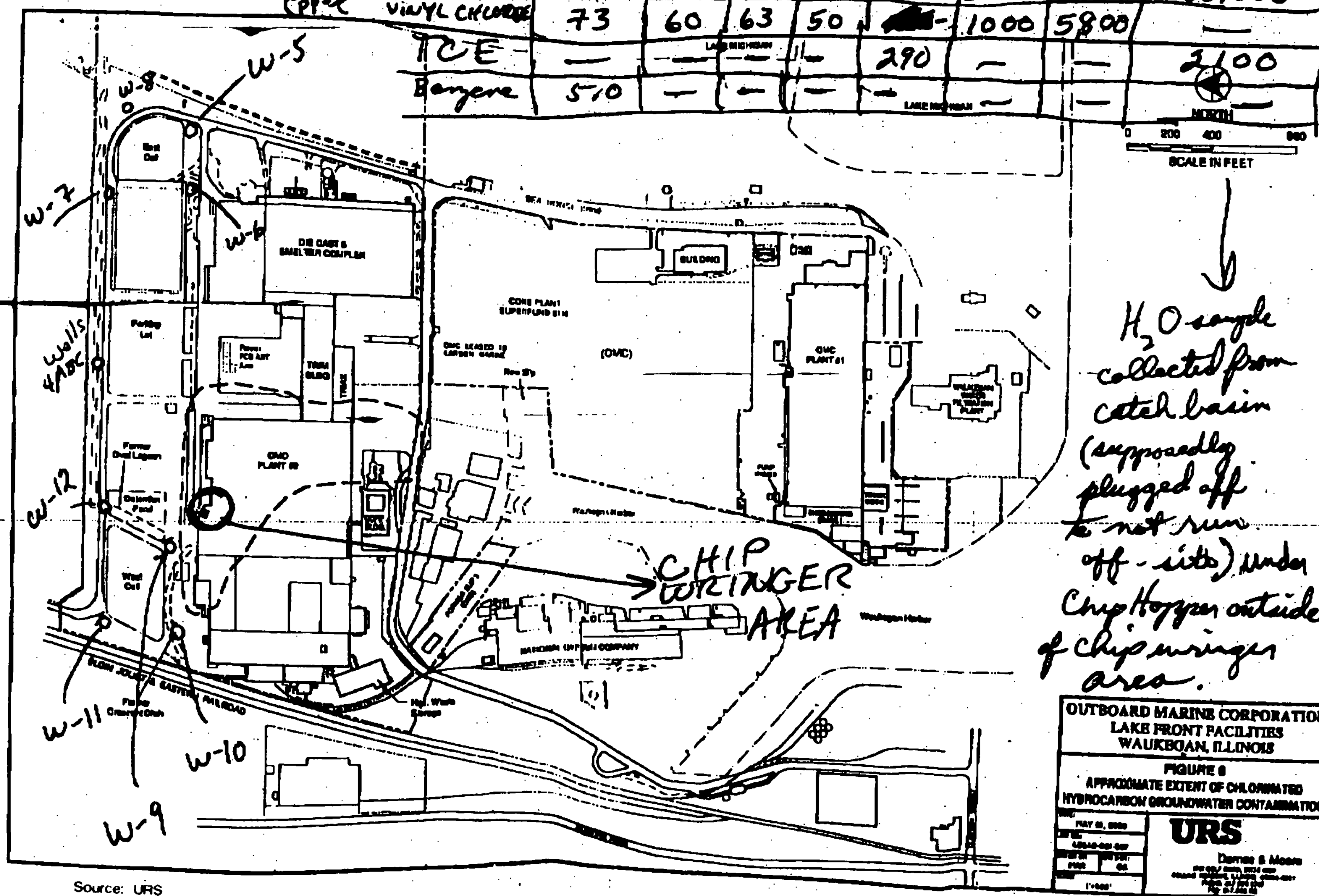
0 200 400 800
SCALE IN FEET

NOTE:
REFER TO UST STATUS TABLE IN REPORT FOR ADDITIONAL INFORMATION.

The following SWMUs/AOCs were identified throughout the facility at various locations:

Plant 1	Plant 2
SWMU 4	SWMU 4
SWMU 5	SWMU 5
SWMU 6	SWMU 6
SWMU 8	SWMU 8
SWMU 9	SWMU 9
SWMU 10	SWMU 10
SWMU 11	SWMU 11
SWMU 12	SWMU 12
SWMU 13	SWMU 13
SWMU 17	SWMU 17
	SWMU 18
	AOC D

		W-4W	W-7	W-12	W-2	W-10	W-9	W-6	CRA-4W2
ug/L (ppb)	CIS 1,2 DCE	660	53	76	78	1100	5800	19,000	160,000
	VINYL CHLORIDE	73	60	63	50	[illegible]	1000	5800	—
	TCE	—	—	—	—	290	—	—	2100
	Benzene	510	—	—	—	—	—	—	—



Source: URS

APPENDIX B

TETRA TECH EM INC. STANDARD OPERATING PROCEDURES

(101 Sheets)

- No. 002 General Equipment Decontamination
- No. 003 Organic Vapor Air Monitoring
- No. 005 Soil Sampling
- No. 006 Sludge and Sediment Sampling
- No. 007 Bulk Materials Sampling
- No. 008 Containerized Liquid, Sludge, and Slurry Sampling
- No. 019 Packaging and Shipping Samples
- No. 024 Recording of Notes in Field Logbook
- No. 044 Hand and Power Augering: Subsurface Soil Sampling Methods
- No. 073 Air Quality Monitoring

SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

GENERAL EQUIPMENT DECONTAMINATION

SOP NO. 002

REVISION NO. 2

Last Reviewed: December 1999

KRiesing

Quality Assurance Approved

February 2, 1993

Date

- Alconox
- Tap water
- Distilled water
- Plastic sheeting
- Aluminum foil
- Methanol or hexane
- Dilute (0.1 N) nitric acid

2.0 PROCEDURE

The procedures below discuss decontamination of personal protective equipment (PPE), drilling and monitoring well installation equipment, borehole soil sampling equipment, water level measurement equipment, and general sampling equipment.

2.1 PERSONAL PROTECTIVE EQUIPMENT DECONTAMINATION

Personnel working in the field are required to follow specific procedures for decontamination prior to leaving the work area so that contamination is not spread off-site or to clean areas. All used disposable protective clothing, such as Tyvek coveralls, gloves, and booties, will be containerized for later disposal. Decontamination water will be containerized in 55-gallon drums.

Personnel decontamination procedures will be as follows:

1. Wash neoprene boots (or neoprene boots with disposable booties) with Liquinox or Alconox solution and rinse with clean water. Remove booties and retain boots for subsequent reuse.

2. Wash outer gloves in Liquinox or Alconox solution and rinse in clean water. Remove outer gloves and place into plastic bag for disposal.

3. Remove Tyvek or coveralls. Containerize Tyvek for disposal and place coveralls in plastic bag for reuse.

4. Remove air purifying respirator (APR), if used, and place the spent filters into a plastic bag for disposal. Filters should be changed daily or sooner depending on use and application. Place respirator into a separate plastic bag after cleaning and disinfecting.

5. Remove disposable gloves and place them in plastic bag for disposal.

5. Decontaminate all pipe placed down the hole as described for drilling equipment.

2.4 WATER LEVEL MEASUREMENT EQUIPMENT DECONTAMINATION

Field personnel should decontaminate the well sounder and interface probe before inserting and after removing them from each well. The following decontamination procedures should be used:

1. Wipe the sounding cable with a disposable soap-impregnated cloth or paper towel.
2. Rinse with deionized organic-free water.

2.5 GENERAL SAMPLING EQUIPMENT DECONTAMINATION

All nondisposable sampling equipment should be decontaminated using the following procedures:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Maintain the same level of protection as was used for sampling.
3. To decontaminate a piece of equipment, use an Alconox wash; a tap water wash; a solvent (methanol or hexane) rinse, if applicable or dilute (0.1 N) nitric acid rinse, if applicable; a distilled water rinse; and air drying. Use a solvent (methanol or hexane) rinse for grossly contaminated equipment (for example, equipment that is not readily cleaned by the Alconox wash). The dilute nitric acid rinse may be used if metals are the analyte of concern.
4. Place cleaned equipment in a clean area on plastic sheeting and wrap with aluminum foil.
5. Containerize all water and rinsate.

SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

ORGANIC VAPOR AIR MONITORING

SOP NO. 003

REVISION NO. 2

Last Reviewed: December 1999

KRiesing

Quality Assurance Approved

April 8, 1994

Date

Organic Vapor: Airborne compounds composed of carbon, hydrogen, and other elements with chain or ring structures

Organic Vapor Analyzer (OVA): A portable instrument used to detect, measure, and provide a direct reading of the concentration of a variety of trace organic gases in the atmosphere through flame ionization

Photoionization: A process involving the absorption of ultraviolet light by a gaseous molecule, leading to ionization

Photoionization Detector (PID): A portable instrument used to detect, measure, and provide a direct reading of the concentrations of a variety of trace organic gases in the atmosphere through photoionization

1.4 REFERENCES

NIOSH/OSHA/USCG/EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." U.S. Government Printing Office. Washington, DC.

EPA. 1994. "Photoionization Detector (PID) HNu." Environmental Response Team SOP #2114 (Rev. #0.0, 10/06/94). On-Line Address: http://204.46.140.12/media_resrcs/media_resrcs.asp?Child1=

1.5 REQUIREMENTS AND RESOURCES

The equipment used to conduct direct monitoring of airborne organic compounds includes the HNu® PID and the Foxboro® OVA FID. Other equipment, such as a Photovac MicroTIP™ PID, is available to conduct similar air monitoring. Calibration gas is also required.

2.0 PROCEDURES

The following subsections present a detailed discussion of direct-reading instrument constraints, accurate recording and interpretation of instrument readings, and general information on the HNu® PID and the Foxboro® OVA FID.

2.3.1 Procedures for Use

The procedures for calibrating and using the HNu® PID, which vary for each model number, are presented in the instruction manual included with the instrument.

2.3.2 Application

The HNu® PID can be used to detect total concentrations of many organic and some inorganic gases and vapors. It can also be used in conjunction with other detection devices such as colorimetric indicator detector tubes to identify specific compounds (see SOP No. 065, Colorimetric Indicator Detectors [Dräeger Tubes]).

2.3.3 Detection Method

The HNu® PID ionizes molecules using ultraviolet (UV) radiation. The radiation strips electrons from the molecules, producing ions that produce a current proportional to the number of ions generated. The HNu® PID is more sensitive to aromatics and unsaturated compounds than the Foxboro® OVA FID. The PID is nonspecific for gas and vapor detection for organics and some inorganics. The PID is also sensitive to 0.1 ppm of benzene. Sensitivity is related to the ionization potential of the compound being monitored.

2.3.4 Limitations

The HNu® PID cannot be used to:

- Detect methane
- Detect a compound that has a lower energy level than the ionization potential of the PID light source
- Respond accurately to a mixture of gases or vapors
- Respond accurately in high humidity or very cold weather
- Respond accurately when interference from other sources is present

2.4.3 Detection Method

Organic gases and vapors are flame-ionized in the OVA FID. The ions produce a current that is proportional to the number of carbon atoms present. The current is interpreted by a deflection on the instrument's meter. In the survey mode, the OVA FID functions as a nonspecific total hydrocarbon analyzer. In the GC mode, the OVA FID can provide a tentative qualitative and quantitative identification of gases and vapors. The OVA FID is most sensitive to saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes), and aromatic hydrocarbons. The OVA FID is not suitable for inorganic gases such as chloride, hydrogen cyanide, and ammonia. The OVA FID is also less sensitive to aromatics and unsaturated compounds than the HNu® PID. However, the OVA FID is less sensitive to high humidity than the HNu® PID. Gases and vapors that contain substituted function groups such as hydroxide (OH-) reduce the detector's sensitivity. Finally, if the operator monitors for a specific gas or vapor, the operator should use a calibration standard and GC column for that particular gas or vapor.

2.4.4 Limitations

The OVA FID cannot be used to:

- Detect organic vapors at temperatures below 40 °F (4 °C)
- Identify specific organic vapors when operated in the survey mode; results must be reported relative to the calibration standard used (for example, as methane equivalents)
- Detect inorganic gases and vapors; the instrument also gives a lower response to oxygen-containing organic compounds (such as alcohols, ethers, and aldehydes) and nitrogen-containing organic compounds (such as amines, amides, and nitriles)
- Detect high organic contaminant concentrations or in oxygen-deficient atmospheres; operation in these conditions requires system modification

2.4.5 General Care and Maintenance

The hydrogen fuel level must be monitored during use to maintain an adequate supply. Also, the OVA FID user should perform routine maintenance procedures described in the instruction manual included with the equipment and routinely check the OVA FID for leaks.

SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

SOIL SAMPLING

SOP NO. 005

REVISION NO. 1

Last Reviewed: December 1999

KRiesing

Quality Assurance Approved

March 23, 1992

Date

Core sampler: Thin-wall cylindrical metal tube with diameter of 0.5 to 3 inches, a tapered nosepiece, a "T" handle to facilitate sampler deployment and retrieval, and a check valve (flutter valve) in the headpiece.

Spatulas or Spoons: Stainless steel instruments for collecting loose unconsolidated material.

Trier: Tube cut in half lengthwise with a sharpened tip that allows for collection of sticky solids or loosening of cohesive soils.

Trowel: Tool with a scooped blade 4 to 8 inches long and 2 to 3 inches wide with a handle.

Split-Spoon (or Split-Barrel) Sampler: Thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to drill rods.

Thin-Wall Tube Sampler: Steel tube (1 to 3 millimeters thick) with tapered bottom edge for cutting. The upper end is fastened to a check valve that is attached to drill rods.

1.4 REFERENCES

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EPA. 1991. "Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells." March. EPA/600/4-89/034.

EPA. 1994. "Soil Sampling." Environmental Response Team SOP #2012 (Rev. #0.0, 11/16/94). On-Line Address: http://204.46.140.12/media_resrcs/media_resrcs.asp?Child1=

2.1 TEST PIT SOIL SAMPLING

Test pit soil sampling is conducted when a complete soil profile is required or as a means of locating visually detectable contamination. This type of sampling provides a detailed description of the soil profile and allows for multiple samples to be collected from specific soil horizons. Prior to conducting any test pit or trench excavation with a backhoe, the sampling team should ensure that the sampling area is clear of utility lines, subsurface pipes, and poles.

A test pit or trench is excavated by incrementally removing soil material with a backhoe bucket. The excavated soil is placed on plastic sheeting well away from the edge of the test pit. A test pit should not be excavated to depths greater than 4 feet unless its walls are properly stabilized.

Personnel entering the test pit may be exposed to toxic or explosive gases and oxygen deficient environments. Air monitoring is required before entering the test pit and the use of appropriate respiratory gear and protective clothing is mandatory. At least two persons must be present at the test pit before sampling personnel enter the excavation and begin soil sampling.

Test pits are not practical for depths greater than 15 feet. If soil samples are required from depths greater than 15 feet, samples should be obtained using test borings instead of test pits. Test pits are also usually limited to a few feet below the water table. In some cases, a pumping system may be required to control the water level within the pits.

Access to open test pits should be restricted by use of flagging, tape, or fencing. If a fence is used, it should be erected at least 6 feet from the perimeter of the test pit. The test pit should be backfilled as soon as possible after sampling is completed.

Soil samples can be collected from the walls or bottom of a test pit using various equipment. A hand auger, bucket auger, or core sampler can be used to obtain samples from various depths. A trier, trowel, or spoons can be used to obtain samples from the walls or pit bottom surface.

deposited onto plastic sheeting. This procedure is repeated until the desired depth is reached and the soil sample is obtained. The auger is then removed from the boring and the soil sample is collected directly from the auger into an appropriate sample container.

2.2.2 Bucket Auger

A bucket auger, equipped similarly as the hand auger, is used to obtain disturbed samples from a depth of up to 4 feet. A bucket auger should be used when sampling stony or dense soil that prohibits the use of a hand-operated core or screw auger. A bucket auger with closed blades is used in soil that cannot generally be penetrated or retrieved by a core sampler.

The bucket auger is rotated while downward pressure is exerted until the bucket is full. The bucket is then removed from the boring, the collected soil is placed on plastic sheeting, and this procedure is repeated until the appropriate depth is reached and a sample is obtained. The bucket is then removed from the boring and the soil sample is transferred from the bucket to an appropriate sample container.

2.2.3 Core Sampler

A hand-operated core sampler (Figure 1), similarly equipped as the hand auger, is used to obtain samples from a depth of up to 4 feet in uncompacted soil. The core sampler is capable of retrieving undisturbed soil samples and is appropriate when low concentrations of metals or organics are of concern. The core sampler should be constructed of stainless steel. A polypropylene core sampler is generally not suitable for sampling dense soils or sampling at an appreciable depth.

The core sampler is pressed into the soil at an angle of 45 to 90 degrees from horizontal and is rotated when the desired depth is reached. The core is then removed, and the sample is placed into an appropriate sample container.

2.3 SUBSURFACE SOIL SAMPLING

Subsurface soil sampling, in conjunction with borehole drilling, is required for soil sampling from depths greater than approximately 6 feet. Subsurface soil sampling is frequently coupled with exploratory boreholes or monitoring well installation. Refer to SOP Nos. 045, 046, and 047 (borehole drilling SOPs) and SOP No. 020 (Monitoring Well Installation).

Subsurface soil sampling may be conducted using a drilling rig or power auger. Selection of sampling equipment depends upon geologic conditions and the scope of the sampling program. Two types of samplers used with machine-driven augers—the split-spoon sampler and the thin-wall tube sampler—are discussed below. All sampling tools should be cleaned before and after each use in accordance with SOP No. 002 (General Equipment Decontamination). Both the split-spoon sampler and the thin-wall tube sampler can be used to collect undisturbed samples from unconsolidated soils. The procedures for using the split-spoon and thin-wall tube samplers are presented below.

2.3.1 Split-Spoon Sampler

Split-spoon samplers are available in a variety of types and sizes. Site conditions and project needs such as large sample volume for multiple analyses determine the specific type of split-spoon sampler to be used. Figure 3 shows a generic split-spoon sampler.

The split-spoon sampler is advanced into the undisturbed soil beneath the bottom of the casing or borehole using a weighted hammer and a drill rod. The relationship between hammer weight, hammer drop, and number of blows required to advance the split-spoon sampler in 6-inch increments indicates the density or consistency of the subsurface soil. After the split-spoon sampler has been driven to its intended depth, it should be removed carefully to avoid loss of sample material. In noncohesive or saturated soil, a catcher or basket should be used to help retain the sample.

After the split-spoon sampler is removed from the casing, it is detached from the drill rod and opened. If VOA samples are to be collected, VOA vials should be filled with soil taken directly from the split-spoon sampler. Samples for other specific chemical analyses should be taken as soon as the VOA sample has

FIGURE 1

HAND-OPERATED CORE SAMPLER

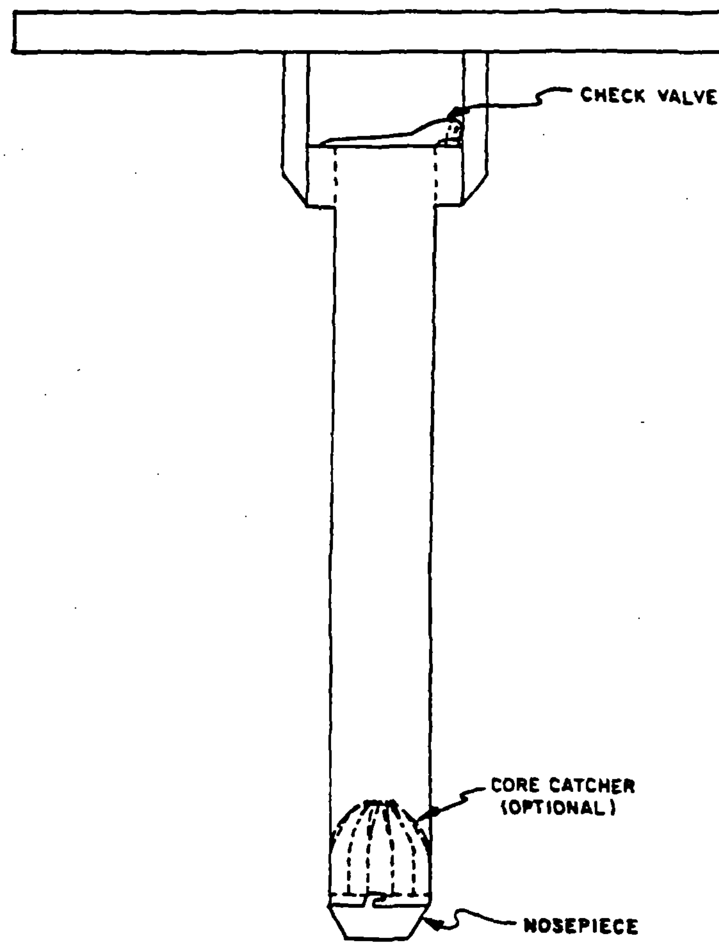
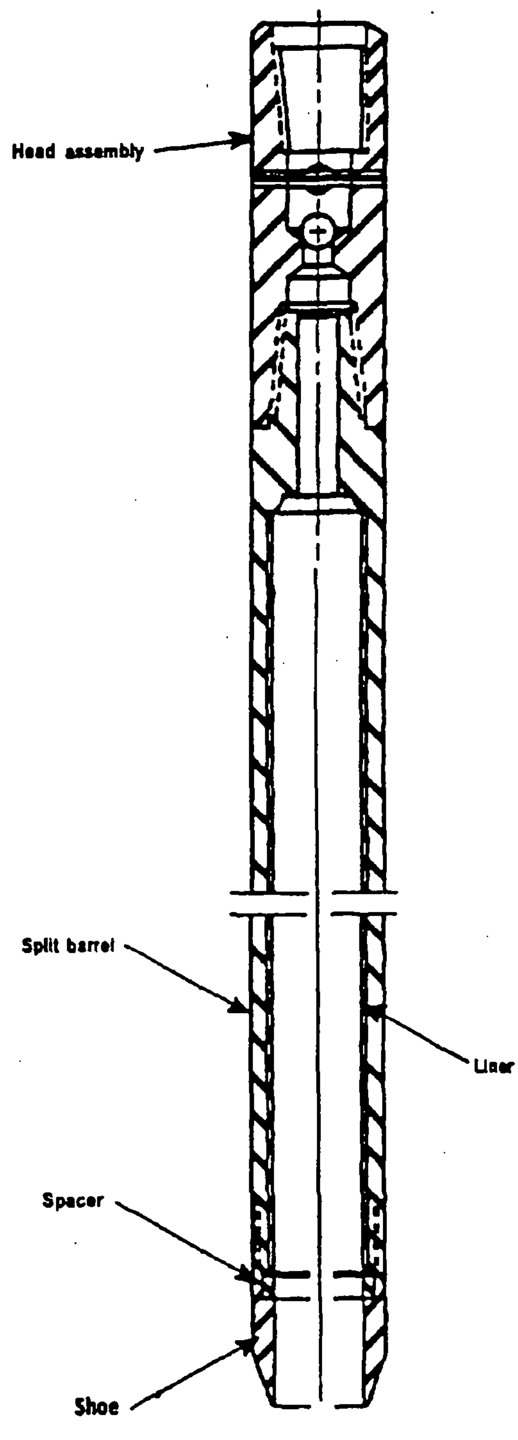


FIGURE 3

GENERIC SPLIT-SPOON SAMPLER



SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

SLUDGE AND SEDIMENT SAMPLING

SOP NO. 006

REVISION NO. 3

Last Reviewed: January 2000

KRiesing

Quality Assurance Approved

May 18, 1993

Date

1.4 REFERENCES

American Public Health Association. 1975. "Standard Methods for the Examination of Water and Wastewater." 14th Edition. Washington DC.

U.S. Environmental Protection Agency (EPA). 1984. "Characterization of Hazardous Waste Sites -- A Methods Manual. Volume II -- Available Sampling Methods." Second Edition. EPA-600/A-84-076. December.

EPA. 1994. "Sediment Sampling." Environmental Response Team SOP #2016 (Rev. #0.0, 11/17/94). On-Line Address: http://204.46.140.12/media_resrcs/media_resrcs.asp?Child1=

1.5 REQUIREMENTS AND RESOURCES

The selection of sampling equipment and procedures should be based on project objectives and site-specific conditions such as the type and volume of sludge or sediment to be sampled, sampling depth, and the type of sample required (disturbed or undisturbed). The selected sampling equipment should be constructed of inert materials that will not react with the sludge or sediment being sampled.

The following equipment may be required to sample sludge or sediment:

- Plastic sheeting
- Field logbook
- Spoons or spatulas
- Stainless-steel scoop or trowel
- Gravity corer
- Ponar grab sampler
- Stainless-steel or Teflon® tray
- Hand corer
- Nylon rope
- Sample containers and labels
- Chain-of-custody and shipping materials
- Decontamination materials

depositional environments and, whenever possible, should be obtained from slow-moving pools. In addition, a sediment sample should be collected at approximately the same location as an associated aqueous sample. Aqueous samples should be obtained first to avoid collecting suspended particles that may result from sediment sampling. To avoid disturbing an area to be sampled, sampling locations in streams should always be approached from the downstream side.

Sediment samples collected from lakes and impoundments should also be collected at approximately the same locations as associated aqueous samples. As in stream sampling, aqueous samples should be collected first to avoid collecting suspended particles that may result from sediment sampling. Downgradient and background samples should be collected from similar depositional environments.

Exact sampling locations should be documented in field logbooks or on data sheets with respect to fixed reference points. In addition, the presence of rocks, debris, or organic material in the sludge or sediment to be sampled may preclude use or require modification of sampling equipment.

The following subsections specify methods for sludge or sediment sampling with specific equipment.

2.1 SAMPLING WITH A SCOOP OR TROWEL

Sludge or sediment samples may be collected with a simple scoop or trowel. This method is more applicable to sludge but can also be used for sediments, provided that the water is very shallow (a few inches). However, using a scoop or trowel may disrupt the water-sediment interface and cause substantial sample alteration. This method provides a simple, quick means of collecting a disturbed sample of sludge or sediment.

The following procedure can be used for sampling sludge or sediment with a scoop or trowel:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.

2. Affix a completed sample container label to the appropriate sample container.

3. Position a precleaned hand corer above the sampling location. Carefully deploy the hand corer into the sludge or sediment using a smooth, continuous motion.

4. When the hand corer is at the desired depth, rotate the "T" handle and retrieve the hand corer using a single, smooth motion.

5. Remove the nosepiece and extract the sample. Place the sample on a clean stainless-steel or Teflon® tray.

6. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.

7. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.

8. Ensure that a Teflon® liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.

9. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements.

10. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

2.3 SAMPLING WITH A GRAVITY CORER

A gravity corer (see Figure 2) can collect essentially undisturbed samples to profile strata that develop in sediment and sludge during the deposition process. Depending on the sediment or sludge density and the gravity corer's weight, the sampler typically can penetrate the sediment or sludge to a depth of 30 inches.

Gravity corers should be used carefully in open drums, shallow tanks, or lagoons with liners. A gravity corer could penetrate beyond the sludge or sediment layer and damage the liner material.

The following procedure can be used for sampling sludge or sediment with a gravity corer:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.

2. Affix a completed sample container label to the appropriate sample container.

2. Affix a completed sample container label to the appropriate sample container.

3. Attach the required length of sample line to a precleaned Ponar grab sampler. Braided, 3/4-inch nylon line is recommended for ease in hoisting.

4. Measure the distance from the water surface or other reference point to the top of the sludge or sediment. Mark this measurement on the sample line. To avoid unnecessary disturbance of the sludge or sediment from lowering the Ponar grab sampler too quickly, it is recommended that a second mark be made on the sample line to indicate the proximity of the reference mark.

5. Open the Ponar sampler's jaws until they are latched. The jaws will be triggered if the Ponar sampler comes in contact with or is supported by anything other than the sample line. Tie the free end of the sample line to a fixed support.

6. Position the Ponar grab sampler above the sampling location. Lower the sampler until the proximity mark is reached. Then, slowly lower the Ponar grab sampler until it touches and penetrates the sludge or sediment.

7. Allow the sample line to slacken a few inches to release the latching mechanism that closes the sampler's jaws. As the jaws close, they scoop the sludge or sediment up into the sampler. More slack may be required when sampling in surface waters with strong currents.

8. Retrieve the sampler and release its contents into a stainless-steel or Teflon® tray.

9. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.

10. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.

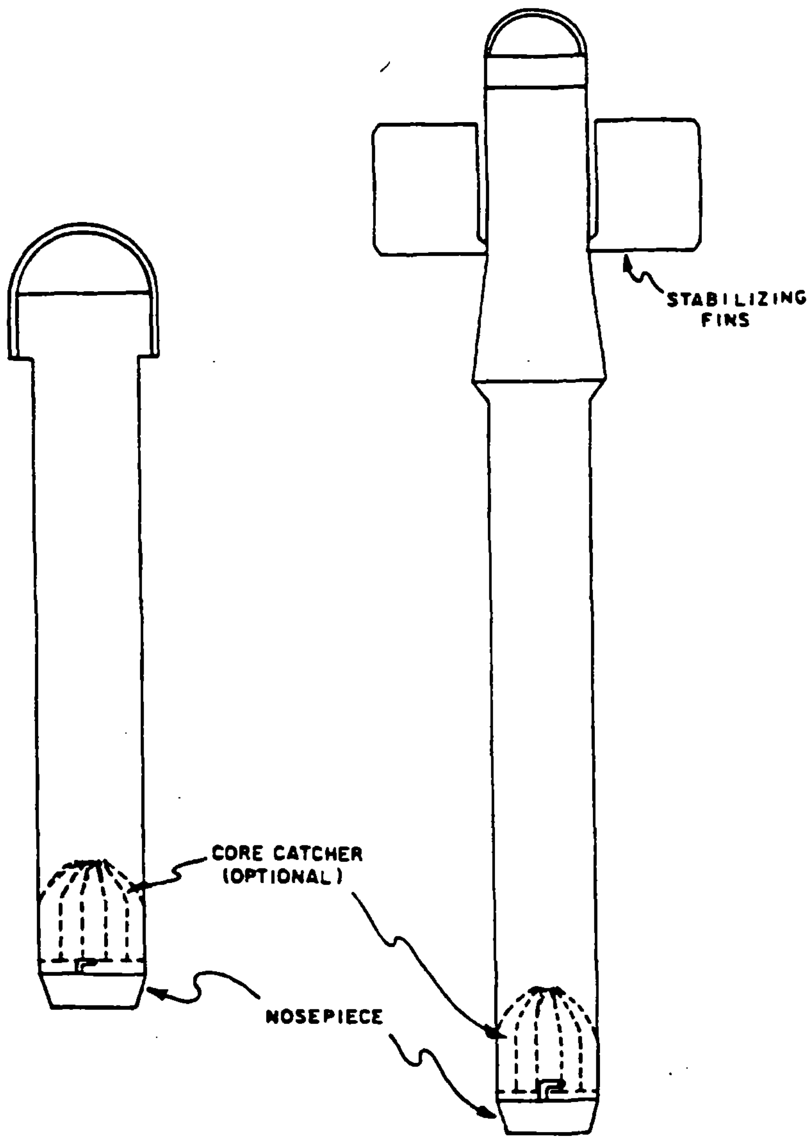
11. Ensure that a Teflon® liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.

12. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements.

13. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

FIGURE 2

GRAVITY CORER



SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

BULK MATERIALS SAMPLING

SOP NO. 007

REVISION NO. 2

Last Reviewed: December 1999

KRiesing

Quality Assurance Approved

May 19, 1993

Date

1.4 REFERENCES

deVera, E.R., and others. 1980. "Samplers and Sampling Procedures for Hazardous Waste Streams." EPA-600/2-80-018. January.

Horwitz, W., and others. 1979. "Animal Feed: Sampling Procedure." *Official Methods of Analysis*. The Association of Official Analytical Chemists. 12th Edition. Washington, DC.

U.S. Environmental Protection Agency. 1984. "Characterization of Hazardous Waste Sites—A Methods Manual: Volume II. Available Sampling Methods." Second Edition. EPA-600/4-84-076. December.

1.5 REQUIREMENTS AND RESOURCES

Sampling of bulk materials can be performed by a variety of equipment. The selection of sampling equipment and procedures should be based on site-specific conditions such as the type and volume of material to be sampled. The selected sampling equipment should be constructed of inert materials that will not react with the material being sampled. The following equipment may be required to sample bulk materials:

- Trier
- Scoop
- Trowel
- Grain thief
- Spoons or spatulas
- OVA® or HNu®
- Decontamination materials
- Sample containers and labels
- Chain-of-custody and shipping materials
- Field logbook
- Stainless-steel or Teflon® tray

Additional resources for sampling bulk materials are discussed in *The Sampling of Bulk Materials* by R. Smith and G. V. James of the Royal Society of Chemistry, London (1981). Although this book does not

A trowel is shaped like a small shovel; the blade is usually 3 to 5 inches long and has a sharp tip. A scoop is similar to a trowel, but the blade is usually more curved and has a closed upper end to contain the sampled material. Scoops are available in different sizes and shapes; stainless-steel and polypropylene scoops with blades 3 to 6 inches long are recommended. Trowels can be purchased from hardware stores; scoops are generally available from laboratory supply companies.

The following procedure can be used to sample bulk materials with a trier, scoop, or trowel:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 017, Sample Collection Container Requirements.

2. Wear appropriate protective clothing and gear. Use an HNu® or OVA® to monitor for levels of volatile organic vapors that may be present in accordance with SOP No. 003, Organic Vapor Air Monitoring.

3. Affix a completed sample container label to the appropriate sample container.

4. Insert a clean trier, scoop, or trowel (implement) into the material at a 0 to 45 degree angle from horizontal. This orientation minimizes sample spillage.

5. If the material is cohesive, rotate the implement once or twice to cut a core of material.

6. Slowly withdraw the implement, making sure the slot or blade is facing upward.

7. If composite sampling is required, repeat steps 4 through 6 at different points two or more times. Combine the samples in a stainless-steel bowl or similar container.

8. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.

9. Ensure that a Teflon® liner is present in the cap of the sample container cap, if required. Secure the cap tightly on the sample container.

10. Complete all chain-of-custody documents, field logbook entries, and packaging requirements.

11. Decontaminate all nondisposable sampling implements after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

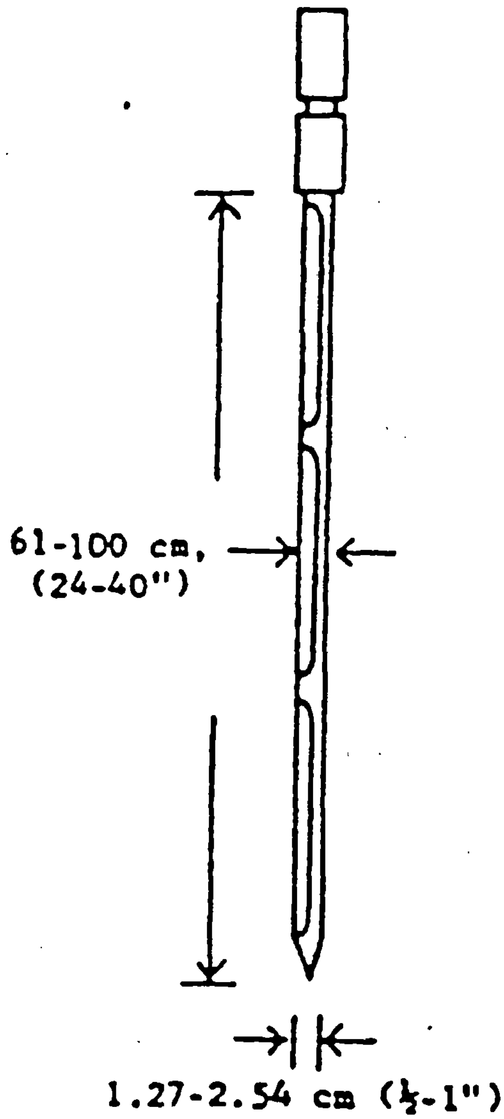
9. Ensure that a Teflon® liner is present in the cap of the sample container, if required. Secure the cap tightly on the sample container.

10. Complete all chain-of-custody documents, field logbook entries, and packaging requirements.

11. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

FIGURE 2

GRAIN THIEF



SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

CONTAINERIZED LIQUID, SLUDGE, AND SLURRY SAMPLING

SOP NO. 008

REVISION NO. 2

Last Reviewed: January 2000

KRiesing

Quality Assurance Approved

May 18, 1993

Date

COLIWASA: Composite liquid waste sampler used to sample free-flowing liquids and slurries in containers.

Hazardous Samples: Hazardous samples include dangerous goods and hazardous substances. Hazardous samples shipped by air should be packaged and labeled in accordance with procedures specified by the International Air Transportation Association (IATA) Dangerous Goods Regulations (DGR); ground shipments should be packaged and labeled in accordance with the U.S. Department of Transportation (DOT) Hazardous Materials Regulations (HMR, *Code of Federal Regulations*, Title 49 [49 CFR] Parts 106 through 180). See SOP No. 019 (Packaging and Shipping Samples) for additional information.

Photoionization Detector (PID): A direct-reading air monitoring instrument used to measure organic vapors based on the principle of photoionization. Examples of PIDs include the HNu and the Microtip.

Flame Ionization Detector (FID): A direct-reading, air monitoring instrument used to measure organic vapors based on the principle of flame ionization. An example of an FID is an organic vapor analyzer (OVA).

1.4 REFERENCES

American Society for Testing and Materials (ASTM) 1997. "Standard Practice for Sampling With a Composite Liquid Waste Sampler (COLIWASA)." ASTM D 5495-94.

ASTM. 1997. "Standard Guide for Sampling of Drums and Similar Containers by Field Personnel." ASTM D 6063-96.

deVera, E.R., B.P. Simmons, R.D. Stephens, and D.L. Storm. 1980. "Samplers and Sampling Procedures for Hazardous Waste Streams." EPA/600/2-80-018. January.

U.S. Environmental Protection Agency (EPA). 1994. "Drum Sampling." Environmental Response Team SOP #2009 (Rev. #0.0, 11/16/94). On-Line Address: http://204.46.140.12/media_resrcs/media_resrcs.asp?Child1=

on this information and based on the scope of work for the project, the sampling team should consist of at least two persons and develop a safe procedure for opening the container and sampling its contents.

Sampling team members must wear appropriate PPE when opening and sampling containers. In some cases, particularly when the contents of the container are not positively known the sampling team should consider using a remote drum opener to open closed containers. The choice of remote drum opening methods depends on the number of drums to be opened, their contents, and their physical condition. One type of remote drum opener uses hydraulic pressure to push a non-sparking metal spike into either the side or top of the drum.

After the container is opened, headspace gases should be monitored using an intrinsically safe monitoring instrument. At a minimum, a preliminary check using appropriate air-monitoring instruments should be conducted to help determine the level of PPE required and the appropriate sampling method.

Layering or stratification of any material left undisturbed over time is likely. Agitation of the container to homogenize the material can be difficult and is undesirable if the contents of the container are not known. The sampling team must ensure that samples represent the entire contents of the container, not just the contents of a single layer.

For sampling liquid and sludge in drums or other small to medium-sized containers, the glass tube sampling method is recommended. Tubes are available that collect a sample from the full depth of a drum and retain it until placement in a sample container. This sampling method is discussed in detail in Section 2.1. The COLIWASA is widely used to sample containerized and free-flowing liquids and slurries in drums and other containers. It also is used for sampling immiscible liquid-phase waste. Use of the COLIWASA is outlined in Section 2.2.

2.1 SAMPLING USING GLASS TUBES

Glass tubes can be used to sample liquids and sludge in containers such as 55-gallon drums. Glass tubes designed for this purpose are normally 122 centimeters (4 feet) long and have an inside diameter of 0.6 to 1.6 centimeters (0.24 to 0.63 inches). Glass tubes with larger inside diameters are used for sampling

8. Slowly insert a glass tube to a level slightly above the bottom of the container or until a solid layer is encountered. If layering or stratification of the liquids in the container is expected, the glass tube should be inserted at a rate that permits the liquid level inside and outside the tube to be about the same. Keep at least 30 centimeters (12 inches) of the glass tube above the top of the container.

9. Allow the liquid in the container to reach its natural level in the glass tube.

10. Cap the top of the glass tube with a safety-gloved thumb or a rubber stopper.

11. Remove the capped glass tube from the container, look for different layers, and insert the uncapped end into the labeled sample container.

12. Release the thumb or rubber stopper from the glass tube to allow the liquid to drain into the sample container.

13. Fill the sample container to approximately 90 percent of its capacity. Repeat steps 8 through 12 if more volume is needed to fill the sample container.

14. Dispose of the glass tube in an appropriate manner.

15. Ensure that a Teflon® liner is present in the sample container cap. Secure the cap tightly on the sample container. All containerized liquid samples should be evaluated in accordance with the "Sample Classification" section of SOP No. 019 (Packaging and Shipping Samples) to determine if they are hazardous samples; hazardous samples should be packaged and shipped in accordance with Dangerous Goods Regulations.

16. Replace the bung in the container or seal the opening in the container with plastic.

17. Complete all chain-of-custody forms and record sampling activities in the field logbook. Unless the sample will be analyzed at the site, complete all sample packaging requirements in accordance with SOP No. 019, Packaging and Shipping Samples.

2.1.2 Sampling Containerized Sludge Using a Glass Tube

The following procedures can be used to sample containerized sludge using a glass tube.

1. Follow steps 1 through 7 for sampling containerized liquids using a glass tube (see Section 2.1.1).

2. Slowly insert a glass tube to a level slightly above the top of the sludge layer. Keep at least 30 centimeters (12 inches) of the glass tube above the top of the container.

3. Allow the liquid in the container to reach its natural level in the glass tube.

Alternatively, if the container opening is sufficiently large, the material may be sampled with a disposable scoop attached to a disposable wooden or plastic rod.

2.2 SAMPLING USING THE COLIWASA

The COLIWASA is used to collect samples of containerized or free-flowing liquid and slurry in drums and other containers. The COLIWASA is commercially available; however, it can be assembled from a variety of materials, including polyvinyl chloride (PVC), glass, or Teflon®. It consists of a 152-centimeter (5-foot) -long tube with an inside diameter of 4 centimeters (1.6 inches). The tube has a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the COLIWASA by raising and lowering the neoprene stopper.

The recommended COLIWASA design is shown in Figure 1. The design may be modified to meet the needs of a sampling situation. The major drawbacks of using a COLIWASA involve decontamination and cost. The COLIWASA is difficult to decontaminate in the field and has a high cost compared to glass tubes. However, disposable COLIWASAs are available and are a viable alternative. The COLIWASA's major advantage is its ability to collect samples that accurately represent a multiphase waste.

The following procedure can be used for sampling containerized liquid or slurry using the COLIWASA:

1. If a commercial COLIWASA is unavailable, select the material to make the COLIWASA (for example, PVC, glass, or Teflon®). Assemble the sampler as shown in Figure 1. Check the COLIWASA to make sure it is functioning properly. Adjust the locking mechanism so that the neoprene stopper provides a thin closure.

2. If using a nondisposable COLIWASA, clean the COLIWASA according to procedures specified in SOP No. 002, General Equipment Decontamination. Place all sampling equipment on a plastic sheet next to the container to be sampled. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Preservation, Holding Time, and Container Requirements.

3. Affix a completed sample container label to the appropriate sample container.

4. Wear appropriate PPE. Use a PID or FID to monitor airborne organic vapors and gases in the breathing zone. In most cases a PID is preferred because it is intrinsically safe, although an FID may be appropriate in some cases.

SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

PACKAGING AND SHIPPING SAMPLES

SOP NO. 019

REVISION NO. 5

Last Reviewed: January 2000

RRiesing

Quality Assurance Approved

January 28, 2000

Date

Dangerous goods: Dangerous goods are articles or substances that can pose a significant risk to health, safety, or property when transported by air; they are classified as defined in Section 3 of the DGR (IATA 1999).

Environmental samples: Environmental samples include drinking water, most groundwater and ambient surface water, soil, sediment, treated municipal and industrial wastewater effluent, and biological specimens. Environmental samples typically contain low concentrations of contaminants and when handled require only limited precautionary procedures.

Hazardous Materials Regulations: The HMR are DOT regulations for the shipment of hazardous materials by air, water, and land; they are located in 49 CFR 106 through 180.

Hazardous samples: Hazardous samples include dangerous goods and hazardous substances. Hazardous samples shipped by air should be packaged and labeled in accordance with procedures specified by the DGR; ground shipments should be packaged and labeled in accordance with the HMR.

Hazardous substance: A hazardous substance is any material, including its mixtures and solutions, that is listed in Appendix A of 49 CFR 172.101 and its quantity, in one package, equals or exceeds the reportable quantity (RQ) listed in the appendix.

IATA Dangerous Goods Regulations: The DGR are regulations that govern the international transport of dangerous goods by air. The DGR are based on the International Civil Aviation Organization (ICAO) Technical Instructions. The DGR contain all of the requirements of the ICAO Technical Instructions and are more restrictive in some instances.

Nonhazardous samples: Nonhazardous samples are those samples that do not meet the definition of a hazardous sample and **do not** need to be packaged and shipped in accordance with the DGR or HMR.

Overpack: An enclosure used by a single shipper to contain one or more packages and to form one handling unit (IATA 1999). For example, a cardboard box may be used to contain three fiberboard boxes to make handling easier and to save on shipping costs.

- Resealable plastic bags for sample jars and ice
- Tape (strapping and clear)
- Appropriate shipping containers as specified in the DGR
- Labels that apply to the shipment such as hazard labels, address labels, "Cargo Aircraft Only" labels, and package orientation labels (up arrows)

2.0 PROCEDURES

The following procedures apply to packaging and shipping nonhazardous and hazardous samples.

2.1 SAMPLE CLASSIFICATION

Prior to sample shipment, it must be determined whether the sample is subject to the DGR. Samples subject to these regulations shall be referred to as hazardous samples. If the hazardous sample is to be shipped by air, then the DGR should be followed. Any airline, including FedEx, belonging to IATA must follow the DGR. As a result, FedEx **may not** accept a shipment that is packaged and labeled in accordance with the HMR (although in most cases, the packaging and labeling would be the same for either set of regulations). The HMR states that a hazardous material may be transported by aircraft in accordance with the ICAO Technical Instruction (49 CFR 171.11) upon which the DGR is based. Therefore, the use of the DGR for samples to be shipped by air complies with the HMR, but not vice versa.

Most environmental samples are not hazardous samples and do not need to be packaged in accordance with any regulations. Hazardous samples are those samples that can be classified as specified in Section 3 of the DGR, can be found in the List of Dangerous Goods in the DGR in bold type, are considered a hazardous substance (see definition), or are mentioned in "Section 2 - Limitations" of the DGR for countries of transport or airlines (such as FedEx). The hazard classifications specified in the DGR (and the HMR) are as follows:

Class 1 - Explosives

- Division 1.1 - Articles and substances having a mass explosion hazard shipped and any noncompressed gas that is either flammable or toxic. A compressed gas is defined as having a pressure over 40 pounds per square inch (psi) absolute (25 psi gauge). Most air samples and empty cylinders that did not contain a flammable or toxic gas are exempt from the regulations. An empty hydrogen cylinder, as in a flame ionization detector (FID), is considered a dangerous good unless it is properly purged with nitrogen in accordance with the HMR. A landfill gas sample is usually considered a flammable gas because it may contain a high percentage of methane. Class 3, flammable liquids, are based on the boiling point and flash point of a substance. Most class 3 samples include solvents, oil, gas, or paint-related material collected from drums, tanks, or pits. Division 6.1, toxic substances, is based on oral toxicity (LD_{50} [lethal dose that kills 50 percent of the test animals]), dermal toxicity (LD_{50} values), and inhalation toxicity (LC_{50} [lethal concentration that kills 50 percent of the test animals] values). Division 6.1 substances include pesticides and cyanide. Class 7, radioactive material, is defined as any article or substance with a specific activity greater than 70 kiloBecquerels (kBq/kg) (0.002 [microCuries per gram [μCi/g]). If the specific activity exceeds this level, the sample should be shipped in accordance with Section 10 of the DGR. Class 8, corrosives, are based on the rate at which a substance destroys skin tissue or corrodes steel; they are not based on pH. Class 8 materials include the concentrated acids used to preserve water samples. Preserved water samples are not considered class 8 substances and should be packaged as nonhazardous samples. Class 9, miscellaneous dangerous goods, are substances that present a danger but are not covered by any other hazard class. Examples of class 9 substances include asbestos, polychlorinated biphenyls (PCB), and dry ice.

Unlike the DGR, the HMR includes combustible liquids in hazard class 3. The definition of a combustible liquid is specified in 49 CFR 173.120 of the HMR. The HMR has an additional class, ORM-D, that is not specified in the DGR. "ORM-D material" refers to a material such as a consumer commodity, that although otherwise subject to the HMR, presents a limited hazard during transport due to its form, quantity, and packaging. It must be a material for which exceptions are provided in the table of 49 CFR 172.101. The DGR lists consumer commodities as a class 9 material.

In most instances, the hazard of a material sampled is unknown because no laboratory testing has been conducted. A determination as to the suspected hazard of the sample must be made using knowledge of the site, field observations, field tests, and other available information.

2.3 PACKAGING HAZARDOUS SAMPLES

The procedures for packaging hazardous samples are summarized below. Note that according to the DGR, all spellings must be exactly as they appear in the List of Dangerous Goods, and only approved abbreviations are acceptable. The corresponding HMR regulations are provided in parentheses following any DGR referrals. The HMR must be followed only if shipping hazardous samples by ground transport.

1. Determine the proper shipping name for the material to be shipped. All proper shipping names are listed in column B of the List of Dangerous Goods table in Section 4 of the DGR (or column 2 of the Hazardous Materials Table in 49 CFR 172.101). In most instances, a generic name based on the hazard class of the material is appropriate. For example, a sample of an oily liquid collected from a drum with a high photoionization detector (PID) reading should be packaged as a flammable liquid. The proper shipping name chosen for this sample would be "flammable liquid, n.o.s." The abbreviation "n.o.s." stands for "not otherwise specified" and is used for generic shipping names. Typically, a specific name, such as acetone, should be inserted in parentheses after most n.o.s. descriptions. However, a technical name is not required when shipping a sample for testing purposes and the components are not known. If shipping a hazardous substance (see definition), then the letters "RQ" must appear in front of the proper shipping name.

2. Determine the United Nations (UN) identification number, class or division, subsidiary risk if any, required hazard labels, packing group, and either passenger aircraft or cargo aircraft packing instructions based on the quantity of material being shipped in one package. This information is provided in the List of Dangerous Goods (or Hazardous Materials Table in 49 CFR 172.101) under the appropriate proper shipping name. A "Y" in front of a packing instruction indicates a limited quantity packing instruction. If shipping dry ice or a limited quantity of a material, then UN specification shipping containers do not need to be used.

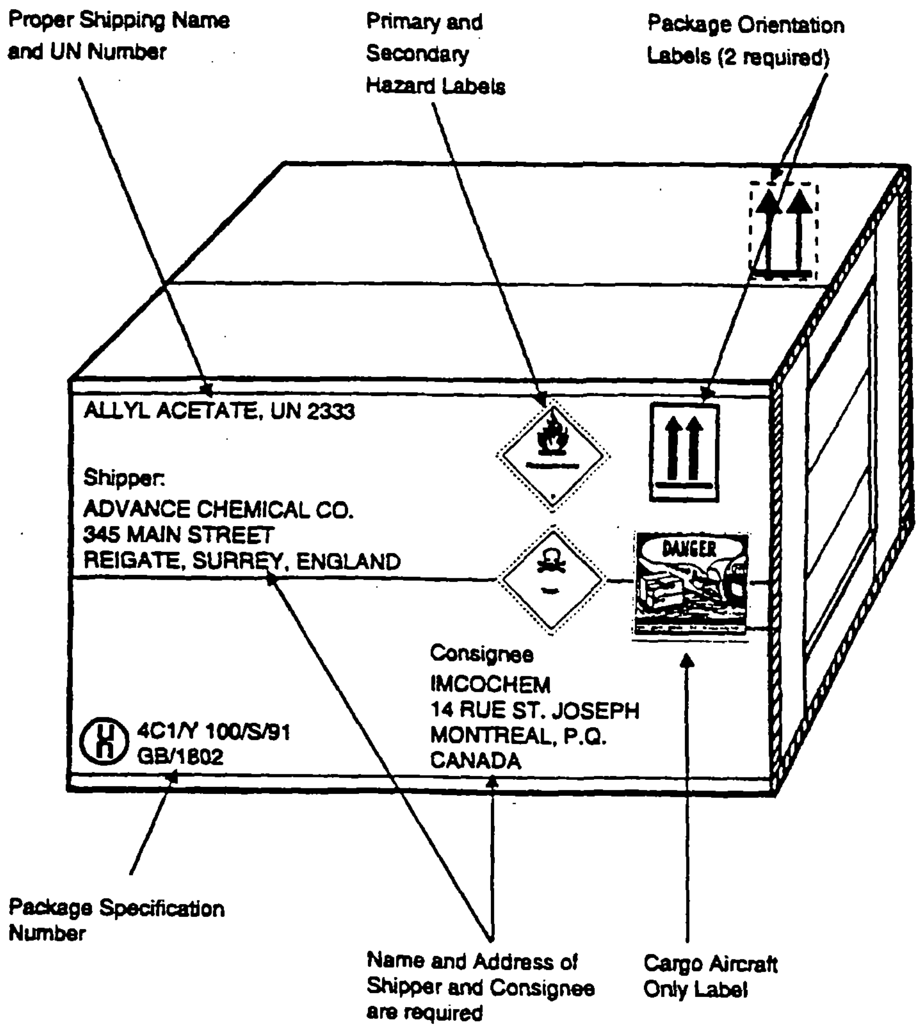
3. Determine the proper packaging required for shipping the samples. Except for limited quantity shipments and dry ice, these are UN specification packages that have been tested to meet the packing group of the material being shipped. Specific testing requirements of the packages is listed in Section 6 of the DGR (or 49 CFR 178 of the HMR). All UN packages are stamped with the appropriate UN specification marking. Prior planning is required to have the appropriate packages on hand during a sampling event where hazardous samples are anticipated. Most samples can be shipped in either a 4G fiberboard box, a 1A2 steel drum, or a 1H2 plastic drum. Drums can be purchased in 5- and 20-gallon sizes and are ideal for shipping multiple hazardous samples. When FedEx is used to ship samples containing PCBs, the samples must be shipped in an inner metal packaging (paint can) inside a 1A2 outer steel drum. This method of packaging PCB samples is in accordance with FedEx variation FX-06, listed in Section 2 of the DGR.

the declaration and the waybill. An example of a completed Dangerous Goods Airbill is depicted in Figure 2. A shipper's declaration must contain the following:

- Name and address of shipper and recipient
- Air waybill number (not applicable to the HMR)
- Page ___ of ___
- Deletion of either "Passenger and Cargo Aircraft" or "Cargo Aircraft Only," whichever does not apply
- Airport or city of departure
- Airport or city of destination
- Deletion of either "Non-Radioactive" or "Radioactive," which ever does not apply
- The nature and quantity of dangerous goods. This includes the following information in the following order (obtained from the List of Dangerous Goods in the DGR): proper shipping name, class or division number, UN identification number, packing group number, subsidiary risk, quantity in liters or kilograms (kg), type of packaging used, packing instructions, authorizations, and additional handling information. Authorizations include the words "limited quantity" or "LTD. QTY." if shipping a limited quantity, any special provision numbers listed in the List of Dangerous Goods in the DGR, and the variation "USG-14" when a technical name is required after the proper shipping name but not entered because it is unknown.
- Signature for the certification statement
- Name and title of signatory
- Place and date of signing certification
- A 24-hour emergency response telephone number for use in the event of an incident involving the dangerous good
- Emergency response information attached to the shipper's declaration. This information can be in the form of a material safety data sheet or the applicable North American Emergency Response Guidebook (NAERG; DOT 1996) pages. Figure 3 depicts the appropriate NAERG emergency response information for "Flammable liquids, n.o.s." as an example.

FIGURE 1

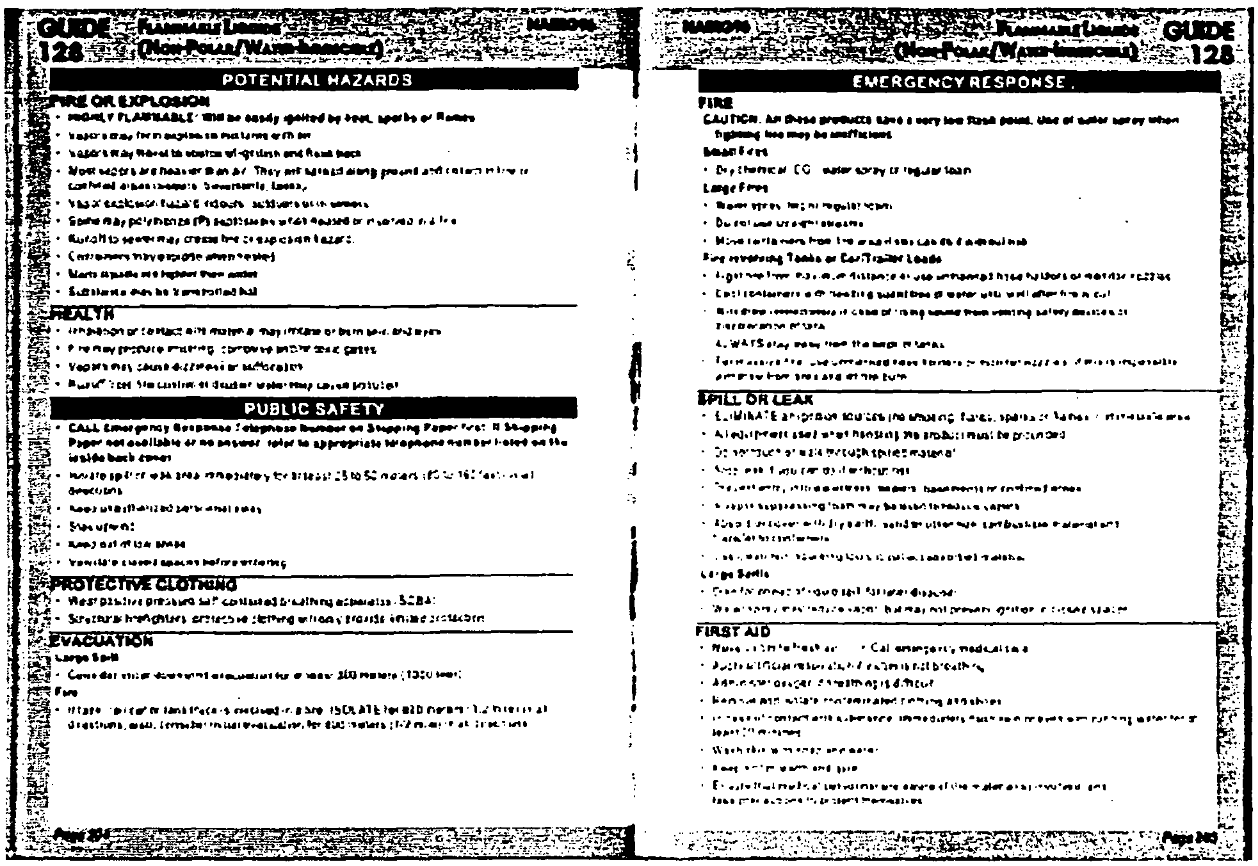
EXAMPLE OF A CORRECTLY MARKED AND LABELED DANGEROUS GOODS PACKAGE



Source: International Air Transport Association (IATA). 1997.

FIGURE 3

NAERG EMERGENCY RESPONSE INFORMATION FOR FLAMMABLE LIQUIDS, N.O.S.



Source: DOT and others. 1996.

SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

RECORDING OF NOTES IN FIELD LOGBOOK

SOP NO. 024

REVISION NO. 1

Last Reviewed: November 1999

K Riesing

Quality Assurance Approved

May 18, 1993

Date

1.5 REQUIREMENTS AND RESOURCES

The following items are required for field notation:

- Field logbooks
- Ballpoint pens with permanent ink
- 6-inch ruler (optional)

Field logbooks should be bound (sewn) with water resistant and acid-proof covers; they should have preprinted lines and wide columns. They should be approximately 7 1/2 by 4 1/2 inches or 8 1/2 by 11 inches in size. Loose-leaf sheets are not acceptable for field notes. If notes are taken on loose paper, they must be transcribed as soon as possible into a regular field logbook by the same person who took the notes.

Logbooks can be obtained through the Document Control Administrator (DCA) for each office. The DCA will have assigned each logbook an identification number. The DCA will make sure the pages in the logbooks are preprinted with consecutive numbers or are consecutively numbered by hand. If the numbers are written by hand, then numbers should be circled so that they are not confused with data.

2.0 PROCEDURES

The following subsections provide general guidelines and formatting requirements for field logbooks and detailed procedures for completing field logbooks.

2.1 GENERAL GUIDELINES

- A separate field logbook must be maintained for each project. If a site consists of multiple subsites, designate a separate logbook for each subsite. For special tasks, such as periodic well water-level measurements, data from multiple subsites may be entered into one logbook which contains only one type of information.

- All logbooks must be bound and contain consecutively numbered pages.

- No pages can be removed from the logbook for any purpose.

- Name of subsite if applicable
- Type of activity
- Beginning and ending dates of activities entered into the logbook
- "Tetra Tech EM Inc." City and State
- "REWARD IF FOUND"

Some of the information listed above, such as the list of activities and ending dates, should be entered after the entire logbook has been filled or after it has been decided that the remaining blank pages in the logbook will not be filled.

The spine of the logbook should contain an abbreviated version of the information on the cover. For example: "1, Col. Ave., Hastings, 5/88 - 8/88."

2.2.2 First Page of the Field Logbook

Spaces are usually provided on the inside front cover (or the opening page in some logbooks), for the company name ("Tetra Tech EM Inc."), address, and telephone number. If preprinted spaces for this information are not provided in the logbook, write the information on the first available page.

2.3 ENTERING INFORMATION IN THE LOGBOOK

Enter the following information at the beginning of each day or whenever warranted during the course of a day:

- Date
- Starting time
- Specific location
- General weather conditions and approximate temperature

- On-site measurement data (pH, temperature, specific conductivity)
- Field observations (odors, colors, weather, etc.)
- Preliminary sample description
- Type of preservative used
- Instrument readings

2.4 PRECAUTIONS

Custody of field logbooks must be maintained at all times. Field personnel must keep the logbooks in a secure place (locked car, trailer, or field office) when the logbook is not in personal possession. Logbooks are official project documents and must be treated as such.

SOP APPROVAL FORM

PRC ENVIRONMENTAL MANAGEMENT, INC.

STANDARD OPERATING PROCEDURE

**HAND AND POWER AUGERING:
SUBSURFACE SOIL SAMPLING METHODS**

SOP NO. 044

REVISION NO. 3

Approved by:

Kathleen Homer

Quality Assurance Officer

5/20/93

Date

1.3 DEFINITIONS

Hand Auger: The hand auger is usually composed of a crossbar, auger stem, and head. The auger stem is compatible with a number of different heads. Additional lengths of pipe can be added to the stem as depth increases. Many types of auger heads exist, and their utility depends on the specific type of soil sampling required. Auger head types include: bucket, Iwan, ship (screw), and spiral (open and closed) heads (Figure 1).

Bucket and Iwan Auger Heads: These heads are used when soils are relatively fine grained, dry, and unconsolidated (both of these augers resemble post-hole diggers). These auger heads are ineffective when used for gravelly or clayey soils. The bucket auger head produces a good borehole in competent, cohesive, dry material. The Iwan auger head is most effective in moderately plastic, moist clays. Both augers provide intact depth-discrete samples.

Sampling Auger Head: This head is used when a depth-discrete sample is to be collected. This head is identical to the bucket auger head except that the top of the head is closed and liners can be installed to retain soils for physical or chemical testing. This auger head also is effective in retaining samples in cohesionless soils.

Ship Auger: This head, also called a helical or screw head, is used when a depth-discrete sample is unnecessary and the soil material is competent and dry. This auger head is best applied for exploratory drilling prior to sampling.

Spiral Augers: These augers are used when helical augers do not work well. The closed-spiral is used in dry clays and gravelly soils. The open spiral is most useful in loose unconsolidated sediments.

Power Auger: Generally, power augers are equipped with one type of bit, the solid stem screw auger bit. The power source for a typical post-hole power auger is a gasoline powered engine, but generator-equipped augers with a wheel-mounted motor are available. The power source for a two-man auger is generally located at the top of the auger stem.

Other more sophisticated mobile augers are available. These are capable of drilling to greater depths, but they operate with a similar auger stem. These types of augers have the same limitation -- they cannot be used to obtain discrete samples.

1.4 REFERENCES

U.S. Environmental Protection Agency (EPA). 1984. (*Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods.*) Second Edition. EPA-600/4-84-076. December.

EPA. 1987. *A Compendium of Superfund Field Operations Methods*. OSWER Directive 9355.0-14. EPA/540/P-87/001. December.

1.5 REQUIREMENTS AND RESOURCES

Soil sampling using the hand or power auger method requires that one or more of the following types of equipment be used:

<u>Sampling Equipment</u>

Hand auger with appropriate auger head

Power auger

Power source for power auger

Fuel for gasoline-powered augers

<u>Other Required Equipment</u>

Logbook

Sample containers and paperwork

2. Carry sampling equipment to the sampling location. Be sure all equipment rests on plastic sheeting next to the sampling location, if required to prevent sample contamination.

3. Locate the sample area by surveying or sketching, and note recognizable features for future reference.

4. Affix a completed sampling label to the appropriate sampling jar.

5. Insert the bucket auger into the soil and advance it to the appropriate depth as described above in Section 2.1.

6. Collect the samples for VOC analysis by scooping the sample material directly into the sample jar using a precleaned stainless-steel spoon.

7. If the soil samples are to be composited or mixed, transfer the remaining soil sample from the bucket auger into a precleaned stainless-steel mixing bowl, aluminum pan, or Teflon tray. Mix the sample with a precleaned stainless-steel spoon or equivalent, and remove all foreign material (rocks, wood, debris, etc.). Monitor the sample with the appropriate health and safety equipment and record the results.

8. Transfer the sample into an appropriate sample bottle using the stainless-steel spoon.

9. If required, check that a Teflon® liner is present in the cap. Secure the cap tightly.

10. Complete all chain-of-custody documents, the field logbook, and sample packaging requirements.

11. Decontaminate sampling equipment after use and between sample intervals according to SOP No. 002, "General Decontamination." If disposable sampling equipment is used, properly containerize the equipment for disposal.

2.3 POWER AUGER DRILLING METHOD

The power auger should be equipped with a reverse and forward drive. Place the power auger on a flat surface and hold it firmly in place while the drive is engaged. With the one-man auger, the motor attachment should be equipped with a support arm, which stabilizes the auger during drilling. With the two-man auger, each operator should hold the unit from an opposite side and level with the ground surface. When the auger is advanced to the appropriate depth, clear the material from around the borehole to prevent caving and engage the reverse drive to remove the bit from the borehole.

3.3 CAUTION

Buried utility lines may present a significant hazard during both manual and power augering. Be sure to obtain and document in the logbook, utility clearances for electric lines, gas lines, water lines, product lines, phone cables, and any other utilities before augering is initiated.

SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

AIR QUALITY MONITORING

SOP NO. 073

REVISION NO. 1

Last Reviewed: November 1999

KMiesing

Quality Assurance Approved

May 26, 1993

Date

1.4 REFERENCES

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Oliver, K. D., et all. 1986. "Sample Integrity of Trace Level Volatile Organic Compounds in Ambient Air Stored in SUMMA® Polished Canisters." *Atmos. Environ.* 20:1403-1411.

U.S. Environmental Protection Agency (EPA). 1983. *Quality Assurance Handbook for Air Pollution Measurement Systems. Volume II of Ambient Specific Methods*. EPA/600/4-77-027a. Washington, DC.

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EPA. 1988. *Compendium Method TO-14, The Determination of Volatile Organic Compounds (VOC) in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatographic Analysis*. Quality Assurance Division. Research Triangle Park, North Carolina.

1.5 REQUIREMENTS AND RESOURCES

Depending on the type of air quality sampling to be conducted, some or all of the following equipment will be required:

- A General Metal Works Model PS-1 High Volume Sampler® is needed to collect samples of airborne particulates and SVOCs.
- A Spectrex Model PAS-3000 Personal Air Sampler® with a carbon molecular sieve (CMS) cartridge or a Tenax gas chromatograph (GC) adsorbent cartridge may be used to collect samples of VOCs.
- A SUMMA® canister may be used to collect samples of VOCs.
- A Gelman GN® filter is needed to collect samples of asbestos fibers.

flow rates and housing design favor the collection of particulates with diameters between 0.1 and 100 microns. A collection efficiency of 99 percent can be obtained for particulates with a 0.3-micron diameter.

After passing through the filter, air enters the lower portion of the PS-1 sampler where it passes through a 3-inch-long, cylindrical glass cartridge containing the PUF plug cartridge. The PUF plug cartridge adsorbs SVOCs, pesticides, and PCBs. The sampling efficiencies of the PUF plug cartridge for various compounds are provided in EPA analytical method TO-4.

Airborne particulates also can be sampled using two other types of instruments: a total suspended particulate meter and a PM-10 sampler. These instruments can be used to capture particulates less than 10 microns in diameter. Both of these samplers use a battery-driven pump to draw air through a filter to capture the particulates. The filter is submitted to an analytical laboratory where it is weighed to determine particulate levels.

2.1.2 Volatile Organic Compounds and Asbestos

A Spectrex Model PAS-3000 Personal Air sampler® (PAS-3000 sampler) can be used to sample VOCs and asbestos. The PAS-3000 sampler draws air through an asbestos filter and a CMS cartridge or a Tenax GC cartridge. The PAS-3000 sampler operates using a series of eight 1.25-volt rechargeable nickel-cadmium batteries connected in series. The maximum flow rate through the PAS-3000 sampler is 500 milliliters per minute. The PAS-3000 sampler can operate continuously for 6 to 10 hours before its batteries need to be replaced or recharged.

Air is first drawn through a filter that captures asbestos fibers. Asbestos fibers are collected using a 25-millimeter-diameter Gelman GN® filter. This filter is made from mixed cellulose esters and has a pore size of 0.8 micron.

Air is then drawn through the CMS cartridge or Tenax GC cartridge. The CMS cartridge used in the PAS-3000 sampler is a Model 300 Supelco Carbotrap. This stainless-steel cartridge is filled with three specialized adsorbents: Carbotrap C, Carbotrap, and Carbosieve S-III®. Glass wool plugs separate the adsorbent materials and are packed into the ends of the cartridge. The CMS cartridge is specifically located a sufficient distance apart so that the sample collected from at least one site will be representative of the true air quality, even if a slight shift from the optimal wind direction occurs.

Air quality samplers should be located in unobstructed areas at least 2 meters from any obstacle to air flow. The exhaust hose of each sampler should be stretched out downwind of the sampler's intake port to prevent any recycling of air.

2.3 CRITERIA FOR INITIATING SAMPLING

The decision to initiate sampling should be made only after carefully analyzing meteorological conditions. The meteorological conditions that are required before initiating sampling include the following:

- Winds from a selected direction sector that will produce net transport from the waste site toward the downwind air quality monitors and a forecast that these winds will persist throughout the sampling event
- Atmospheric stabilities in the neutral to stable range; moderately unstable conditions also acceptable for summer sampling events
- No precipitation

Air quality samples can be collected as discrete grab samples. However, samples are generally collected continuously over a period of several hours, and a minimum sampling time of 2 hours is usually desirable. The exact duration of the sampling will be based on the meteorological conditions, the requirements of the sampling equipment, and the individual project objectives.

2.4 EXPERIMENTAL PROCEDURE AND ANALYSIS

This section details the protocols and procedures for collecting, handling, and analyzing air quality samples. A sampling event can range from collecting a single grab sample to continuous sampling over a 24-hour period depending on meteorological conditions, instrument performance, and project objectives. After sampling is completed, the filters and cartridges from the samplers will be collected. All samples will be placed in clean containers, sealed from contact with outside air, and clearly labeled with their sample

In the laboratory, the Teflon® filters will be carefully weighed to measure particulate levels on the filter. PCBs and pesticides will be removed from the PUF plug cartridges using Soxhlet extraction in accordance with EPA analytical method TO-4. The extracts will be analyzed using GC with electron capture detection (ECD) following the procedures outlined in EPA analytical method TO-4.

2.4.2 Volatile Organic Compounds and Asbestos

Before being used to collect samples, the PAS-3000 sampler will be calibrated in the laboratory using a soap film flow meter following the manufacturer's operating manual. A copy of the manufacturer's calibration specifications and calibration results for each project will be maintained in a laboratory logbook.

After a sampling event is scheduled, the necessary PAS-3000 samplers will be deployed in the field. Each CMS cartridge will be transported to the field in a screwtop glass storage container. Asbestos filters will be transported to the field in sealed plastic bags. The clean handling procedures outlined in EPA analytical method TO-4 will be followed for all sampling equipment.

The CMS cartridges and asbestos filters will be installed in the PAS-3000 samplers just before the beginning of a sampling event. After each PAS-3000 sampler is turned on, the serial number of the sampler and the date and time will be recorded in the field logbook.

After the samples have been collected, the PAS-3000 samplers will be turned off and the end dates and times will be recorded in the field logbook. The CMS cartridges will then be removed from the samplers, recapped, and placed in screwtop glass storage containers for transport to the laboratory. The asbestos filters will be resealed in plastic bags for transport to the laboratory.

The CMS cartridges will be analyzed using the procedures outlined in EPA analytical method TO-2 for thermal desorption GC/ECD and flame ionization detectors (FID). The asbestos filters will be analyzed using phase contrast microscopy (PCM) in accordance with federal Occupational Safety and Health Administration standards for asbestos monitoring. The laboratory analyst will document compliance with these standards in the laboratory logbook.